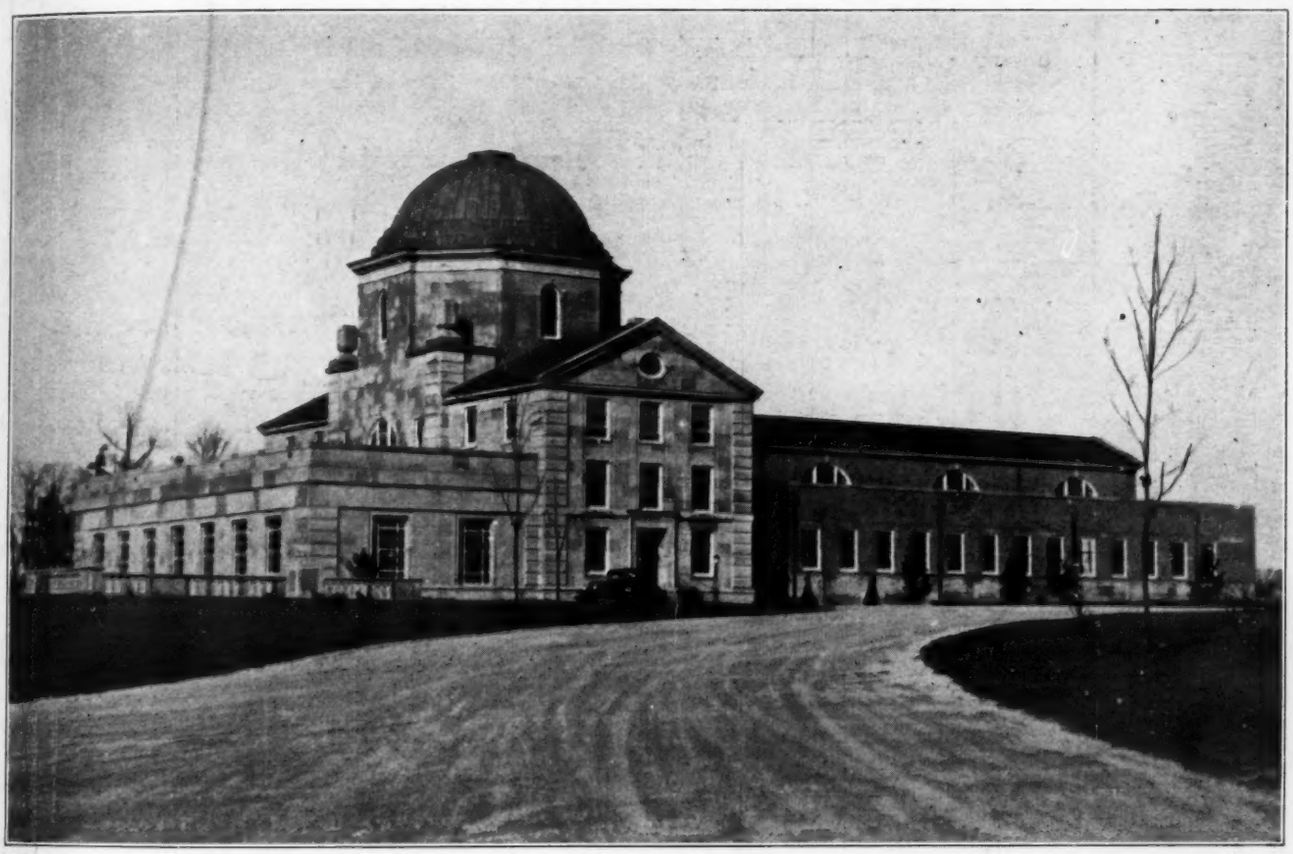
WATER WORKS AND SEWERAGE

November, 1933 — L. H. Enslow, Editor — Vol. LXXX. No. 11



Filtration Plant, Erie, Penn.

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The Cost of Drying Sludge on Sand Beds
Handling Storage Yard Equipment and Supplies
Report of 13th Ohio Conference on Water Purification
Improvements to Water Treatment Plant of Williston, N. Dak.
Experience with Anthracite Coal as a Filter Medium for Water Softening
Report of Joint Meeting of Central States Sewage Works Association and Engineering Section of A. P. H. A.

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II—Hydrogen and Hydroxyl Ions
III—Buffer Action
IV—Determination of pH
V—Sources of Error

Section B. Practical Application of Hydrogen Ion Determinations in Industry and Science

VI—Municipal and Industrial Water Supply
VII—Water Corrosion Problems
VIII—Disposal of Sewage and Industrial Waste
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WATER WORKS & SEWERAGE

L. H. ENSLOW, Editor

LEADING ARTICLES To Appear in the Next and Subsequent Issues:

Joseph Cordillo, Supervisor of Water Service, Lehigh Valley Railroad, Sayre, Pa., will write on boiler water treatment practices with especial reference to methods employed on the Lehigh Valley System and the resulting economies.

Walter A. Sperry, Superintendent of Sewage Treatment Works, Aurora, Ill., will describe a study of flow through characteristics of sewage settling tanks and means evolved to create higher efficiencies including the installation of effective devices.

H. E. Jordan, Sanitary Engineer, Indianapolis Water Company, will review the "Advances in Water Supply and Purification Practices" during the year 1933.

Floyd A. Hoffman, Superintendent of Water Works and Sewerage, Morristown, N. J., will describe a new and interesting device for controlling activated sludge concentration and return of sludge, the use of which has proven its value.

Philip Burgess, Consulting Engineer, Columbus, Ohio, will describe a unique iron removal plant employing contact beds of anthracite coal operated at high rates.

John F. Laboon, Consulting Engineer, Pittsburgh, Pa., will describe the many interesting, novel and practical features incorporated in the design of two new sewage treatment plants under construction at Lancaster, Pa.

Dale L. Maffitt, General Manager of the Des Moines, Ia., Water Department, will discuss the "Measurement of Small Water Flows."

H. H. Hendon, Sanitary Engineer, Birmingham, Ala., will describe a flexible chemical precipitation plant and the process designed for sewage treatment at Birmingham which involves some unique features.

C. P. Hoover, Superintendent of Water Purification, Columbus, Ohio, will describe a new installation for "Unloading, Handling and Feeding Soda Ash" in water softening practice.

C. E. Keefer, Engineer in Charge of Sewage Treatment, Baltimore, Md., will tell of the beneficial results procured from sludge recirculation from bottom to top of digesters.

Dr. Frank E. Hale, Department of Water Supply, New York City, will reveal the results of extended experiments to test "The Solubility of Cement Linings of Pipe and Its Prevention."

Philip J. Martin, Superintendent of Water Works, Tucson, Ariz., will reveal methods employed in the "Control of Algae and B. Coli in Open Reservoirs" at Tucson.

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Published monthly by the GILLETTE PUBLISHING CO., Daily News Building, Chicago, Ill.

Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under the Act of March 3, 1879. Published monthly at 400 W. Madison Street, Chicago, Ill. Per copy 25c. Subscription rates $2.00 per year. Canadian and Foreign, $3.00 per year. Copyright, 1933, by Gillette Publishing Company, Publishers of: Water Works and Sewerage, Roads and Streets, Oil and Soap, The Art of Mosaics and Terrazzo, Road and Street Catalog and Data Book, Water Works Catalog and Data Book.

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Chicago Office, Daily News Building. Cleveland Office, 2100 Keith Building. New York Office, 420 Lexington Avenue. San Francisco Office, 155 Montgomery Street.

Addresses will be changed as frequently as desired, upon notification: not otherwise. Changes of address should be sent in at least two weeks before the date of the next issue of *Water Works and Sewerage*, in order for them to be effective for that number. Immediate notice should be given of any delay in the receipt of the magazine.

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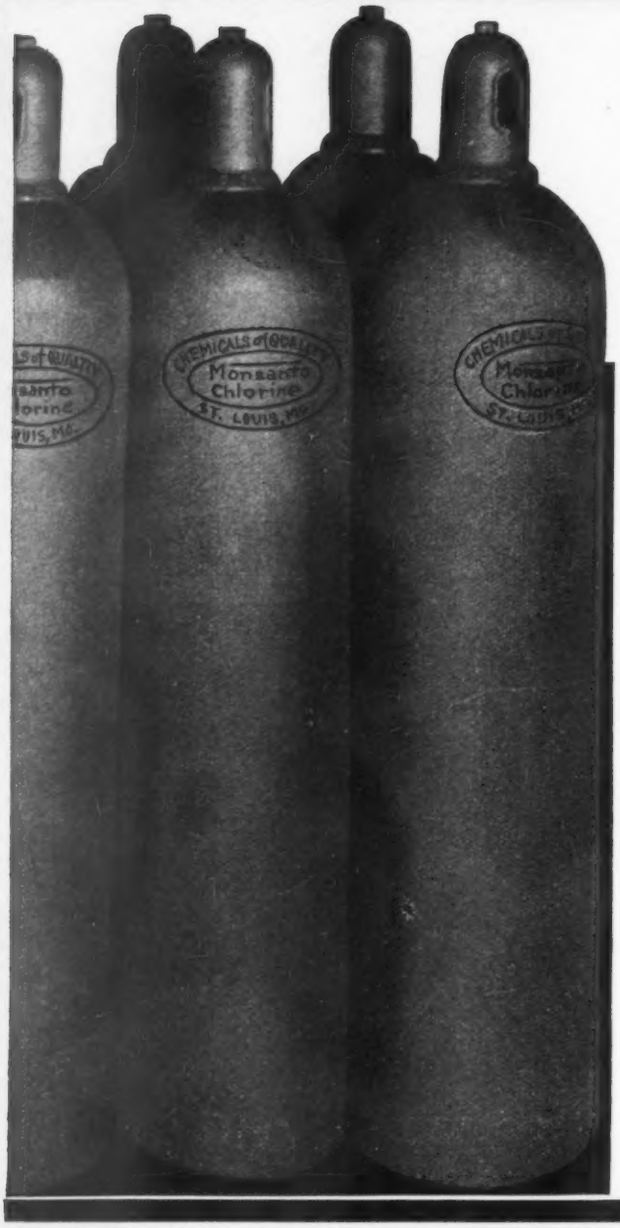

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WATER WORKS AND SEWERAGE
VOL. 80 NO. 11 Nov. 1933
A GILLETTE PUBLICATION

HANDLING STORAGE YARD EQUIPMENT AND SUPPLIES

By J. S. DUNWOODY

Superintendent, Water Department, Erie, Pa.

THE handling of Storage Yard supplies and equipment opens up a field in Water Works practice upon which it is difficult to strike a proper balance between the accurate distribution of all stock and equipment, and the cost of operating improved systems developed for the distribution.

Whether a system can be developed that will work successfully and economically, regardless of the size of the operation, is beyond proof in the writer's experience. It is, however, a foregone conclusion that regardless of the size of a plant some accurate method of handling stock and equipment is most essential to successful operation.

I am satisfied that the system about to be described will accurately and economically distribute stores and small equipment for any Water Department large enough to warrant the employment of two clerks to carry out the details. With modifications, I believe it could be applied in works having demands too small to require full time help to operate the system.

In developing any system an important thing to bear in mind is the correct point of division between the accurate written record and the unnecessary red tape. As soon as you pass this point of division the system becomes, first burdensome, then slow, and if one is not careful, extravagant and inaccurate.

The Stock Room

To properly handle supplies, the first requisite is a properly designed stock room. A place for everything, and everything in its place, is about all that can be written to cover this point. The room should be large enough to permit the orderly placing of all materials stocked so that they are readily accessible and can be quickly inventoried. Segregation of materials of similar character to definite unit parts of the stock room, and these units in turn carefully subdivided as to sizes, kinds, etc., is of great importance.

Inside stock room stores will, of course, vary considerably with operating conditions, such as the number of makes and sizes of meters in the system, repair parts for which must be stocked; whether or not your city has standardized on one make of fire hydrant, as hydrant parts for any repair must be constantly available, and so on down the list of materials used in water works maintenance or construction. It can reasonably be expected that a plant of moderate size, say one required to supply 100,000 people, would have to carry on hand from 800 to 1,000 items of stock at all times.

Supervision of the stock room should be vested in one person, and he held responsible for its operation. This clerk should be selected with care, as he must be a very accurate record keeper and have a working knowledge of a water plant so as to understand the use of the various items of stock he is required to handle.

Stock Record

The individual card system for each item of stock, either tray or book form, on which can be kept a perpetual inventory by entering each transaction, is a most satisfactory method of record keeping. (See Fig. 1.)

The accuracy of this method of record keeping can be attested by the fact that at Erie on the inventory of January 1, 1933, covering stock valued at $55,545.00 there was a discrepancy of only $19.15. This inventory check was made after a full year of operation, and represents the handling of at least $100,000.00 worth of materials and supplies.

While too much importance cannot be attached to the careful keeping of stock on card records, the writer is

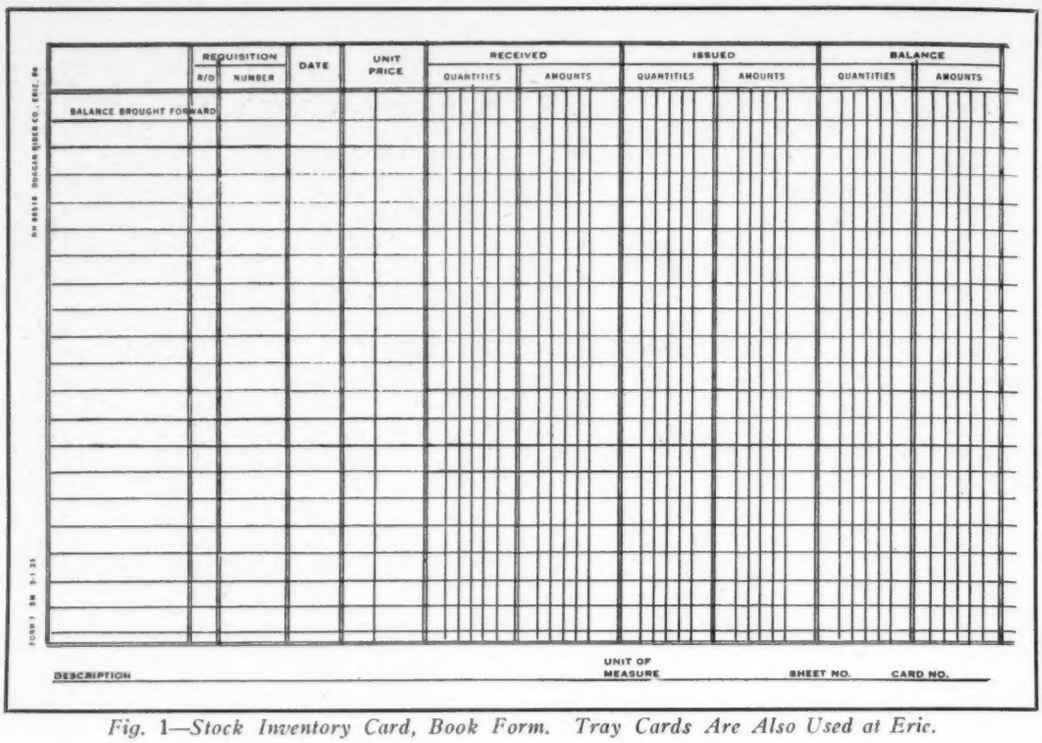


Fig. 1—Stock Inventory Card, Book Form. Tray Cards Are Also Used at Erie.

firmly of the opinion that the most important operation of any stock record system is the distribution.

Requisition for Stores

How, for instance, can curb cocks be drawn from stock, accurately distributed to the job on which they were used, be 100 per cent accounted for, and yet not develop a burdensome lot of bookkeeping at the stock room office?

Unless it is to cover some very special and out of the ordinary job, stores are never distributed by the stock clerk to the individual job or maintenance account. Stock is only distributed on the requisition of a foreman. In filling the requisition, the stock is transferred from the stock inventory record and charged to the account of the individual foreman. A card record of his stock is maintained similar to the general stock room record.

A foreman on his own requisition then completely equips himself for the job to which he is assigned. This method of stores distribution is not limited to materials used in construction, but is applied to the assignment of all tools and equipment that a foreman, in his judgment, feels he needs.

Job Equipment

Let us assume the beginning of a working season, and that the foreman has been ordered to equip for a substantial job on distribution system construction in advance of street paving. The first requirement of this foreman is a place to center his activities, a sort of administrative building, and we have, through an inheritance from our forefathers, elected to call this unit a tool-wagon. It is important that this be more than a storage box, so let us arrange for a practical working unit that can be truly called the job center.

This wagon (Fig. 2), built on the chassis of an abandoned truck, has an inside floor space of 114 sq. ft., is equipped with a field desk, stove for use in cold weather, small open bins for tools and supplies, and closed bins for heavy equipment, boots, oil skins, etc. The bin tops form bench seats for 20 men. Such an arrangement gives a warm dry place for lunch hour in stormy weather. The wagon has a close coupling tongue, and is towed from job to job by a truck. A wagon of this type costs complete about $800.00.

Foreman's Supplies and Equipment

A foreman in equipping for a job will first requisition all necessary tools and supplies. After these have been received, the first procedure is to mark them with his own private identification, for he alone is held responsible for the tools he has taken out on requisition.

Having studied the job to which he has been assigned, he next requisitions the materials which in his judgment will be required to either complete a small job or substantially start a large one.

Being thus equipped, the job is gotten under way with but one concentrated withdrawal from the stock room, and thus a rapid adjustment of the records is made possible. It is, of course, folly to presume that a foreman will not overlook some item, or misjudge quantities on others, and when this happens he forwards by a truck driver, or presents in person, a requisition for additional material. This is supplied by truck delivery and ac-

Fig. 2—The Tool Wagon Is the "Administration Building" of the Foreman and His Men.

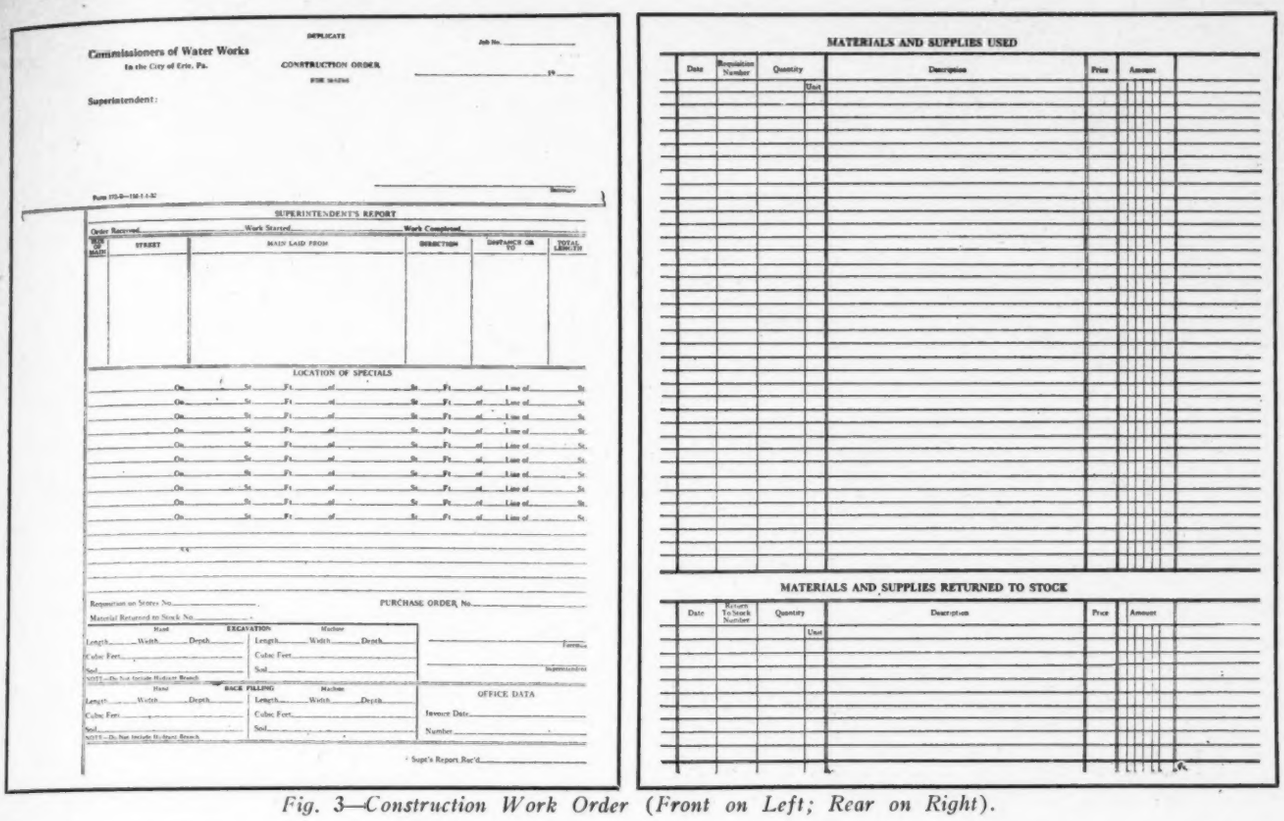


Fig. 3—Construction Work Order (Front on Left; Rear on Right).

counted for by triplicate sheets issued through an autograph register by the stock clerk.

One copy of this record is signed by the receiving foreman and is returned by the truck driver to the stock clerk, thus assurance of a completed and correct transaction is set up for all interested parties.

Once a month the stock clerk lists all stock and equipment charged to each foreman, and a copy is submitted to the foreman for his information. He can very quickly check the correctness of this record, and should a discrepancy occur, an immediate conference between the foreman and stock clerk usually results in locating the error.

Distribution of Stores

The foreman having assumed the responsibility for a quantity of tools and materials must be given a simple but effective method of distribution. The job and account number system we believe to be the easiest to apply, and most accurate in ultimate results.

The job order (Fig. 3) is issued from the main office in triplicate, two copies going to the storage yard office. One copy is retained for permanent record, and the other given to the foreman as the field sheet. The complete job history is recorded on this sheet, and all materials used are reported on a Distribution of Stores blank.

When the job is completed, the foreman makes the complete record on the field sheet, attaches all distributions from his stock, and the entire file is returned to the storage yard office. Here the job is carefully written up on the second copy of the job number, the foreman's stock record given credit for stock used, and the entire file forwarded to the accounting department where detail costs are computed and the permanent job history is recorded.

Whenever a foreman desires to return any materials to the stock room, it must be accompanied by a Materials Returned-to-Stock slip.

The detailed cost sheet as compiled by the accounting department (Fig. 4) is prepared in duplicate, one copy for the superintendent, and the other for the foreman of the particular job. This affords an excellent opportunity to study costs, and to check weak spots in construction methods before they become financial losses.

The Handling of Tools and Equipment

Having covered the distribution of job materials by the foreman, may we not for just a minute consider how he accounts for hand tools and the various equipment

JOB NO. 2129—6-IN. MAIN ON MARYLAND AVENUE, FROM 117 FT. SOUTH OF SOUTH LINE ON 6TH ST., SOUTHWARDLY—96 FT.

Time: Nov. 3 to Nov. 4, 1932
Foreman: Wm. O'Brien

		Amount	Cost Per Ft.
Pipe—96 ft. 6-in. pipe		$36.28	$.378
Specials		None	
Valves and Valve Boxes		None	
Supplies—			
50 lbs. Leadite	$4.54		
4 lbs. Jute	.44		
3 lbs. Clay	.05		
4 gal. Kerosene	.42		
		5.45	.057
Teaming and Trucking—			
Trucking Expense	$1.05		
Trucking Labor	.82		
		1.87	.019
Excavating—Hand 1,176 cu. ft. Yellow Clay		15.32	.160
Laying and Caulking—Labor		4.90	.051
Backfilling—Hand 1,176 cu. ft.		9.77	.102
General Labor		9 57	.100
Foremen		11.67	.121
Storage Yard and Street Department Overhead		31.23	.325
		$126.06	$1.313

Fig. 4—Detailed Cost Sheet Showing Analysis of Expenditures and Materials Used on Each Job.

used by the workmen? For example, every man is assigned a pick, a shovel, an oil skin coat and a pair of boots. Equipment so assigned becomes the sole property of that workman, and he is held fully responsible for it. He must, moreover, turn in worn out equipment before new is assigned. This method may require a slightly larger investment in tools and supplies, but reduces losses to a minimum.

Handling Heavy Materials

The economical and quick handling of heavy materials, especially where large quantities are involved, should be given careful consideration, and in our case a motor crane has been found to meet all requirements.

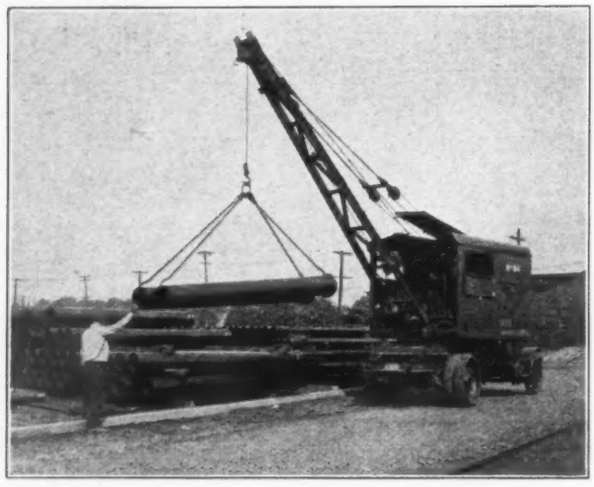


Fig. 5—Portable Equipment for Unloading and Stocking Pipe Is Also Used for Numerous Other Purposes, Including Pipe Laying.

The unloading of pipe in the storage yard (Fig. 5) is but one of many uses of this equipment, but I will not take the time to enumerate the many places it can be operated to advantage. The point I desire to make is that an expensive piece of equipment of this character does not have to be purchased for this one operation. It might be mentioned under the heading of this paper that the setting of large valves by a motor crane can return large dividends to the water company, to say nothing of the speed with which such operations are carried out.

This type of equipment in a great majority of cases will eliminate the need for overhead stationary yard cranes. The loading of pipe for distribution to jobs should be carried out with a minimum of labor, and with a properly arranged stock pile (Fig. 6). This operation can be carried out with a truck driver and a helper.

With the aid of keg mats, the unloading of pipe at the job is simplified and held to a low cost. Four mats are usually used, and the pipe is permitted to drop from the side of the truck to the ground with the mats breaking the fall. Even the most brittle pipe can be successfully unloaded in this manner.

The final handling of pipe, or the placing of same in the trench, is a simple problem until one has to handle the larger sizes. Here the motor crane again proves its value, as it becomes an essential tool for pipe laying in sizes of 16 inch and larger. The trench hoe can also be utilized in the laying of large mains. I can recall one 30 and 36-inch job on which the hoe excavated the trench, placed the pipe as soon as sufficient trench was open for a single length, and then backfilled on the days when laying was not in progress. The job just referred to was one of the most successfully executed main construction operations to come within the writer's experience.

Care of Equipment

The equipment used in water works construction is so varied that it would be folly for me to go into details on the points of uses and values. All departments have equipment, so whether it be the lowly hand operated trench pump or the latest model trench hoe, let us group them all and consider only the care of equipment used in water works construction and maintenance.

Regardless of what the equipment is, it has an expected life. Equipment life is better expressed by the term value, therefore, the longer the life the greater the value.

The first step in the preservation of equipment is to see that it is properly housed. Storage should be provided for every piece of equipment when it is out of active service. Nothing depreciates machinery faster than continued exposure to weather.

The second step to assure long life of equipment is the annual overhauling. Nothing adds faster to the cost of a job than a broken-down piece of equipment, and the only insurance against this is periods of thorough inspection. The operator of every machine should be a mechanic of sufficient ability to work on his machine, under the direction of a master mechanic, during the "lay" periods.

While truck drivers cannot be expected to be auto mechanics, they should be sufficiently instructed to take full responsibility for their truck. Grease and oil, carefully and systematically applied to present day hauling equipment will, with an occasional motor check, assure uninterrupted service.

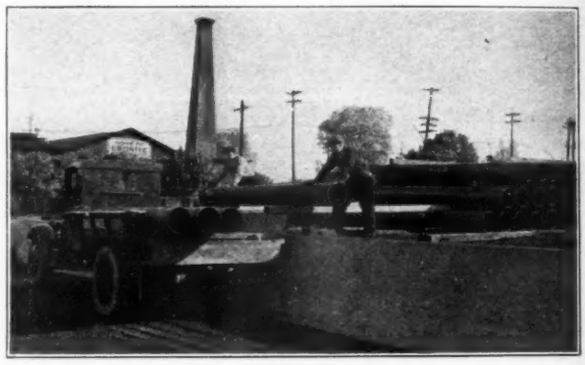


Fig. 6—Stock Pile Arrangement Makes for Ease and Economy in Loading Cast-Iron Pipe.

The third step in the care of equipment carries with it more than operating assurance, because it classifies your standing in the community. The appearance of your equipment while on the streets and highways of your city is considered by the citizens just as surely as your personal appearance. Keep equipment painted, then keep it clean, and you have established one avenue of public relations which can be nothing but favorable.

Acknowledgment.—A paper presented before the American Water Works Association, at Chicago, Ill.

▼

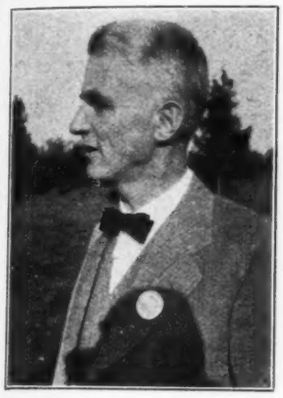
GENEVA, N. Y., VOTES FOR SEWAGE TREATMENT WORKS—At a special election held on Oct. 17, the taxpayers of the city of Geneva voted almost unanimously in favor of a $300,000 bond issue for the construction of intercepting sewers and a sewage treatment plant. These facilities will materially improve the sanitary condition of Seneca lake in the vicinity of the city.

The decision to build these works at the present time places the city in a favorable position to obtain federal aid under the NRA plan.

CENTRAL STATES SEWAGE WORKS ASSOCIATION HOLDS JOINT MEETING WITH ENGINEERING SECTION OF THE A. P. H. A.

THE Central States Sewage Works Association held its 6th annual convention in Indianapolis, on October 12th and 13th—the first session being held jointly with the Public Health Engineering Section of the American Public Health Association which had been in convention since October 9th. The Central States Sewage Works Association is composed of 136 members from the states of Wisconsin, Illinois and Indiana. Members and guests attending the Indianapolis meeting numbered roughly 140, with a registration of 110.

One afternoon was devoted to a trip of inspection to the Indianapolis sewage treatment plant, the garbage reduction plant and the water purification plants of the Indianapolis Water Company, where a modern installation of one ton chlorine container handling arrangements for prechlorination constituted a recent addition effecting operating economy.



C. K. Calvert, Superintendent Sewage Treatment, Indianapolis, Ind.; Retiring President

H. F. Ferguson, Chief Engineer, Illinois Department of Health; President of the Association

Annual Award Established

Secretary-Treasurer G. H. Radebaugh reported the Association to be in a very satisfactory condition financially and that 26 new members had joined during the year.

H. F. Ferguson, in reporting as Chairman of the Committee on Awards, announced that a portion of the income from a government bond owned by the Association was to be used in establishing an award of $20.00 in gold to be given annually to the member presenting the most meritorious paper before the Association during the year previous.

New Officers

Dr. F. W. Mohlman, Chairman of the Nominating Committee, announced that the following members had been named as officers for the year 1933-34. The election was unanimous.

President—H. F. Ferguson, Springfield, Ill.
Vice-President—M. Starr Nichols, Madison, Wis.
Vice-President—O. M. Leonard, Frankfort, Ind.
Secy.-Treas.—G. H. Radebaugh, Urbana, Ill.

The next meeting will be held in Wisconsin—the place and date to be decided by the Executive Committee.

The P. W. A. and Your Town

At the annual dinner Abel Wolman, Federal Public Works Engineer of Maryland, addressed the Association on the relationship of municipalities and their officials to the Public Works Program of the NRA. Mr. Wolman, speaking with the point of view of one closely associated with developments in Washington as well as that of a consultant and a Chief Engineer of a State Department of Health, made it very plain that taxpayers and municipal, county and sanitation district officials, would be forced to realize sooner or later that any failure of the Public Works Administration to obtain cooperation and support from them in making the program of unemployment relief, through betterments and new construction of public works, a nation-wide success would be, "their funeral as it will be that of others." He made a point of the fact that a patriotic point of view should be taken by authorities and taxpayers and that relief of unemployment was apparently being frustrated in some quarters by attempts to devise means and excuses to avoid putting men to work on public works projects. The chief excuse which had been used was that the grant offered municipalities by the administration was not of any true value to the recipient because of the added cost of projects and demoralizing effects of the stipulated rate increases to laborers. Replying to that argument, he stated that the cost of a project of $100,000 proportions would normally be $10,000 per year whereas under the Administration's method of financing the annual net cost over the 25 year period would be less than half that, viz., $4,900 per year. As to any differential in the labor cost it could but be clear to those, who *honestly* believed that the costs would be higher under the Administration's plan, that the 45 cent hourly rate, for the 30 hour week stipulated, would yield the laborer but $12.00 per week. Further, that unless the municipality paid its laborers less than 18 to 20 cents per hour (assuming 50 per cent of the cost to be labor) it would still prove profitable to accept the P. W. A. offer of a loan and grant.

Gus H. Radebaugh, Urbana, Ill., Secretary of the Association and "the Premier Salesman of Sewage Treatment to the Public"

L. S. Finch, Consulting Engineer, Indianapolis, Ind.; Chairman of the Program Committee

Mr. Wolman said, that the causes of delay in getting

public works construction under way were regrettable, as was the fact that local areas needing such betterments and re-employment most, were least able or least willing to take advantage of the Administration's offer. Communities so financially weakened as to be unable to qualify as borrowers, and consequently most needful of relief, should to his mind be given government aid to the extent of a 100 per cent grant, because after all it was the intent of the Public Works Act to relieve unemployment —not to amuse town councils endeavoring to find reasons why they should not support a program in which it was their patroiotic duty to participate.

Status of Public Works Sanitation Projects

State Sanitary Engineers of Wisconsin, Illinois and Indiana reported on the progress made to date with water works and sewerage projects under the P. W. A.

L. F. WARRICK, of Wisconsin, said that 17 water works projects ($1,670,000) had been approved by the Wisconsin Advisory Board. Among these was the filtration plant for Milwaukee which would cost $4,000,000. There were 20 sewerage projects for which loans or grants had been asked. Nine of this number had been approved and funds amounting to $4,300,000 allocated; the eleven others would total more than $5,000,000. Those pending will bring the total in water works and sewerage projects for Wisconsin up to $11,923,000.

H. F. FERGUSON, of Illinois, said that sewage treatment had already been provided for in recent years by most of the cities in Illinois but that 44 applications for P. W. A. aid for sewerage projects (exclusive of Chicago) had been filed. Within the past few weeks there had been a genuine rush of applicants for funds.

L. A. GEUPEL, of Indiana, said that he had noticed a marked recent change in the attitude of the taxpayer to the spending of money by municipalities for sanitary improvements. There were on file applications amounting to $3,000,000 for sewerage projects and about the same for water works. Only $1,500,000 had been allocated to date.

W. W. DEBERARD, of Chicago, said that 6 public works projects in Illinois to cost $17,000,000 had been approved by the P. W. A. The Sanitary District of Chicago was asking for $25,000,000 and to date $8,000,000 had been approved. There were 210 projects for future consideration and 32 were in form ready for hearings. Sewerage projects had accounted for 35 per cent and water works 25 per cent of all those passed—thus indicating the high importance of sewerage in the future.

Technical Sessions

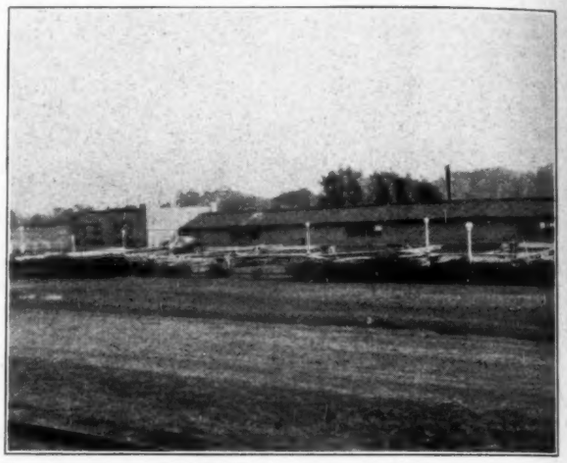
(C. K. Calvert presiding.)

"Recent Advances in the Chemical Treatment of Sewage"—DR. F. W. MOHLMAN, Director of Laboratories, Sanitary District of Chicago, Chicago, Ill.

Dr. Mohlman said, that in keeping with the spirit of the times, involving "new deals" of one sort or another, or as the result of dissatisfaction with biological processes there had been a revival of chemical precipitation processes of sewage treatment during the past few years. Some schemes had been tried on a fairly large scale and others on a fair sized experimental scale but that it was not yet possible to say with assurance what will come of these experiments. Coagulating chemicals and inert materials, such as marl, clay, cement dust and paper pulp, had been used to clarify sewages and zeolite and chlorine had been employed to remove or destroy soluble organic materials. He referred also to the precipitation of nitrogenous and fatty substances from meat packing plant wastes by super-chlorination.

Listing thirteen processes now advocated or under development he said that the most interesting feature of the Stevenson process developed at Palo Alto, Calif., was the return of the chemical sludge. The Wright process under development at Rockville Center, L. I., was unique in that the sewage treated with lime and paper pulp was being filtered through vacuum filters. Of all processes advocated, that of the Guggenheim Laboratories was the most varied and produced the highest purification efficiencies of any because of the removal of nitrogenous compounds by the zeolite beds.

As to comparing the degree of purification afforded by the several chemical processes, a study of reported results indicated that the purification effected lay somewhere between that of plain settling and activated sludge —a reduction of from 60 to 75 per cent in oxygen demand values being procurable. If chlorination was practiced 65 to 80 per cent reduction might be realized.



A Glimpse of the Indianapolis Sewage Treatment Plant

Against this the activated sludge process at Milwaukee produced, on an average 95 per cent oxygen demand reduction and at Chicago and Indianapolis reductions averaged 92.1 per cent. The reported reductions for the chemical processes had been the following:

Place	Process	Per Cent 5 Day B.O.D.	Reduction of Suspended Solids
Dearborn, Mich.	Laughlin	68	91
Coney Island, N.Y.	Laughlin	69*	84**
Atlanta, Ga.	Lewis	77	76
Ashland, O.	Travers	50	85
Philadelphia, Pa.	Streander	75	(Sparkling effluent through sand filter)
Winston Salem, N. C.	Landreth	88	87
Chicago, Ill.	Landreth	66-72	..
Palo Alto, Calif.	Stevenson	60	..
New York City	Guggenheim	95	95
Chicago, Ill.	Guggenheim	90	95

*Raised to 79 per cent by chlorination.
**Raised to 92 per cent by chlorination.

Results from the processes under development by the Diamond Alkali Works, that of Darcey & Scott at Oklahoma City and that of Wright at Rockville Center, L. I., had not been reported to date.

Dr. Mohlman said, that on the whole, criticism might be made that the reported results from chemical processes had been meager and unconvincing. Though it must be admitted that reduction in the cost of the activated sludge process was desirable, advocates of chemical processes had directed loose criticism against the activated sludge process. Admitting a decreased efficiency of the latter at intervals, such as usually of a transitory nature and therefore over emphasized.

The true advances made in chemical precipitation had come about through the use of more adequate and accurate control of chemical coagulants, such as ferric chloride and ferric sulphate, along with improved me-

chanical devices for sludge handling. The value of and the mechanism of chlorination had become better understood. And the use of the B.O.D. test made easier the evaluation of process efficiencies as compared with accepted processes. Filters of special design for effluents had improved performances and the value of the vacuum type filter as a sludge dewatering mechanism had been demonstrated; but failure to incorporate sludge cake incineration had constituted a neglect. The sludge cake produced at rates of 7 to 8 lbs. of dry solids per hour for each square foot of filter surface contained approximately the same water content as that produced from non-chemical sludges and disposal by mechanical filtration and incineration would appear to be the most feasible

M. W. Tatlock, Superintendent Sewage Treatment, Dayton, O. His Problem Is Odor Control; His Hobby, Selling Sludge to Pay for Odor Control.

L. A. Geupel, Chief Engineer Indiana Department of Health, Indianapolis, Ind.

scheme for the larger precipitation plants although per capita costs would be higher than those for other sludges.

Dr. Mohlman commented on the use of the lime-chlorine process in connection with Imhoff tanks at Dayton, Ohio, which had resulted in higher removals of suspended solids and oxygen demand. He also referred to the use of chemical precipitation with iron salts at Grand Rapids, Mich., Plainfield, N. J., and Oklahoma City, Okla. At these points the process had been applied to increase the efficiency of existing treatment works. In this direction, viz., its use for reducing loadings on biological processes and increasing plant capacities or efficiencies—chemical treatment seemed to have a field of usefulness as it also should have in situations where industrial wastes overloaded or otherwise interfered with biological processes. With more study, he thought, chemical processes might be further improved to increase their flexibility and reduce their costs.

F. H. Waring, Chief, Engineer, Ohio State Department of Health, in discussion of Dr. Mohlman's paper, said that chemical processes had a useful place in the scheme of waste disposal but he deplored the "bunk" in some of the claims advanced by the proprietors of chemical processes. In a plant scale demonstration in Ohio, the Travers process had effected a 92 per cent suspended solids removal and a 70 per cent reduction in B.O.D. value. The chemical cost had been unduly high $43.00 (per m.g. treated) and was considered unsatisfactory because the use of marl and lime had been excessive. At East Palestine, O., the new treatment plant was being so designed as to employ chemical precipitation but the addition of secondary biological treatment units had been arranged for, if and when required. A combination of the two treatments might be eventually employed.

He found chemical precipitation had quite an appeal to the layman but he urged that municipal officials and state authorities insist that the proprietors of the process bear the expense of demonstrating their processes, and not the taxpayer. Each treatment problem, he said, should be considered on its own merits and he felt, as Dr. Mohlman did, that the addition of chemical treatment had a future in that it would serve to reduce loadings on secondary processes. It was but fair to all concerned to promptly discourage proponents of chemical processes in every instance where the scheme would appear to fall short of producing required results.

M. W. Tatlock, Superintendent Sewage Treatment, Dayton, O., reported that the lime-chlorine process introduced at Dayton three years ago as an odor control procedure had been more than that. Other advantages such as an additional removal of suspended solids, less foaming tendencies, shrinkage of sludge and scum volume and an additional B.O.D. reduction of 16 per cent by the Imhoff tanks had been amply demonstrated. In 1932 the river flow had been the lowest since the plant was put in operation but no secondary nuisance had resulted indicating that, with chlorination, secondary treatment could be postponed until some future time. The lime-chlorine treatment had involved the use of 75 lbs. of chlorine and 100 lbs. of hydrated lime per million gallons at an added cost of $1.90 per m.g. for treatment of the Dayton sewage.

H. H. Hendon, Sanitary Engineer, Jefferson County, Ala., described a chemical precipitation plant, now under design in his office, for the city of Birmingham, Ala. The plant was so designed as to operate as a plain settling and separate digestion plant for 8 to 9 months each year —and operated as a chemical precipitation plant during the summer period only. The scheme involved primary sedimentation followed by chemical precipitation in the second tank—all sludge so produced being returned to the raw sewage for increasing the solids removal in the primary clarifier. The chemical effluent could finally be filtered through a rapid filter. Chlorinated-copperas was to be used in coagulation in conjunction with prechlorination at a demonstrated chemical cost of $4.00 per m.g.

[The unique features of the Birmingham plant are to be described by Mr. Hendon in an early issue of this magazine.—Editor.]

F. W. Jones of Cleveland, Ohio, in commenting on experiences with chemical precipitation stated that but 15 per cent of the soluble substances in sewages could be removed by chemical precipitation and chemical processes should be evaluated accordingly.

Langdon Pearse, Sanitary Engineer, Chicago, Ill., said that chemical feed in chemical precipitation processes had not been accorded the attention deserved. Inability to properly control chemical feed at the Dearborn plant was especially noticeable and being, on the whole, the most important step in the process, chemical feed control must be improved if chemical precipitation is to become satisfactory in performance and costs. Further, cost data was far too meagre. The future of the process may rightly lie in its application at existing plants to cope with seasonal and special conditions.

"Seeding Material in Sludge Digestion"—C. E. Keefer, Engineer in Charge of Sewage Treatment, Baltimore, Md.

Mr. Keefer's paper, read in his absence by L. H. Enslow, constituted a report on sludge seeding experiments wherein sludges of from a few days to 12 years age were employed as seeding material. Findings of other investigators had led them to believe that old sludge was not a satisfactory seeding material but the Baltimore experiments had indicated (as shown by curves thrown on the screen) that rates of digestion had been highest

with sludge 10.5 years old. Other old sludges had produced similar results equaling if not surpassing those from sludges approaching the last stages of complete digestion. The conclusion to be deducted was that the age of seeding sludge was no criterion in evaluating its value for such purpose unless it was that very old sludge was to be preferred when considered on the basis of a mixture of 1 part volatil matter in fresh solids to 2 parts volatil matter content in the seeding material—both being on the dry solids basis.

"Modernization of Sewage Treatment Works"—E. B. BESSELIEVRE, The Dorr Company, New York, N. Y.

Mr. Besselievre's paper, presented by Mr. Bachman of the same firm, constituted a thorough review of the development of mechanical equipment in the sewage treatment field. Mechanization, he said, had put sewage treatment on a markedly higher plain and had eliminated the unsightly and obnoxious features of sewage treatment plant operation. At the same time operating costs had been reduced along with the hand labor required. Mechanically cleaned bar screens had been especially productive of lower operating costs and grit washing and removal equipment had been, at once, a money saver and nuisance eliminator. The earliest use of a sludge scraper had been that installed in 1908 at Bolton, Eng., whereas of date the Dorr Company alone had equipped 497 plants with mechanisms for sludge removal and there were perhaps a total of twice that number of such devices in use. The application of vacuum filters for sludge dewatering and incineration of screenings and grit had been only very recently on the increase. Separate digestion of sludge had come into its own since 1926. Mechanical equipment for aeration in the activated sludge process had been used for some years. Prior to introduction of Imhoff's idea of using a combination of submerged paddle wheels with air diffusion, the power requirement had seldom been under 30 h.p. per m.g. for mechanical or air blowing schemes. The Imhoff scheme required but 0.2 to 0.3 cu. ft. of air per gallon resulting in an overall power requirement of little more than half that required for air or mechanical aeration alone.

LANGDON PEARSE, Sanitary Engineer, Chicago, Ill., in discussion called attention to improved mechanical methods of sludge handling which had been particularly helpful at Chicago where 2,000 to 3,000 cu. yds. of sludge cake had to be removed from the beds each day. He mentioned also the advantageous use of a small tractor in sludge cake removal from the beds at Springfield, Ill.

"The Treatment of Trade Wastes"—L. F. WARRICK, State Sanitary Engineer, Madison, Wis.

Mr. Warrick commented on the changing attitude of industrialists toward stream pollution problems and plant wastes. Formerly, with abundant business, the manufacturers had no regard for what monetary value might be represented in "leaks" from the plant in the form of trade wastes. Now, however, the manufacturer was more interested in reducing plant waste and also in reducing stream pollution with resulting economy. It was also true that industrialists were becoming more appreciative of the value of composite or cooperative action in matters pertaining to stream pollution remedies and in fostering studies directed toward reducing the wasting of valuable products down the sewer. He particularly mentioned the programs of the American Pulp and Paper Association and the Petroleum Institute. The most practical and basically sound method of attacking industrial waste problems was that of utilization of products formerly wasted; of eliminating needless process water consumption and thereafter treating the reduced waste to remove the residual polluting substances not subject to economical recovery or return to the manufacturing process. Mr. Warrick pointed to the progress made in the paper and pulp industry wherein the so-called white-water was being returned to the system for reuse and thereby converting wasteful practices to economical procedure through use of the so-called "closed system."

Treatment of Milk Wastes

In addition to paper and pulp mill wastes they had been concerned with treatment of wastes from the 4,000 milk and milk-products plants and a large number of canneries in Wisconsin. For milk waste treatment they had settled on the sprinkling filter (8 ft. depth) to which the waste is applied in a fresh condition without prior sedimentation—the dosing being in many instances effected by a rotating distributor, time clock controlled,

Visitors from Canada: A. Cousineau, Sanitary Engineer of the City of Montreal, and Theo. J. La Freniere, Chief Engineer, Department of Health of the Province of Quebec

to operate in cycles of 6 minutes dosing and 9 minutes rest. The humus produced in considerable quantity required secondary settling. The filters, operating 18 hours out of the twenty-four had withstood temperatures of 30 degrees below zero without housing. In reply to questions, Mr. Warrick said that the applied waste averaged 850 p.p.m. oxygen demand value with maximum of 1,800. The oxygen demand reduction had averaged 97 per cent in summer and the minimum efficiency (84.5 per cent) was observed at 30 degrees below zero—leaving a residuum of between 30 and 75 parts of oxygen demand in the effluent. The acidic waste (pH 4.5) was built up to pH 7.2 to 8.2 in passing the filters. Even during coldest weather, with open side filters, the cooling during passage of waste through the bed had been but 10 degrees or thereabouts.

Treatment of Cannery Wastes

Experimental work having indicated a chemical precipitation treatment of pea cannery wastes to be the most practical available scheme, there had been built 33 precipitation plants at Wisconsin canneries. These plants, employing the fill and draw scheme of operation, involved the use of conical bottom tanks equipped with mechanical agitators. From beginning of the tank fill, the cycle of fill and mix, settling and decanting supernatant, sludge withdrawal and return of tank to operation, required two to four hours—the shorter time representing the designed minimum, but actual time being determined by rate of filling. Pea canning wastes were first put through revolving screens (40 mesh) before adding ferrous sulphate (copperas) and lime in amounts of 3.25 lbs. of copperas and 7.25 lbs. of hydrated lime per 1,000 gallons of waste. The lime application was continuous—a final adjustment of pH value to 9.6 being made at the end of the filling period after which all the copperas was added. Mixing discontinued, the rapidly

settling coagulated material is concentrated in the cone bottom, the supernatant decanted, and finally the sludge emptied onto sand dewatering beds from which the sludge cake could be removed after 4 to 6 days for disposal on the land. In recent instances the sludge had been transferred from the precipitation tanks to tank wagons for application direct to the land in the fluid condition. The fluid sludge would occupy a space equal to 10 per cent of the volume of waste treated. The cost of chemical treatment had been under 1 cent per case of peas canned.

When necessary, secondary treatment on trickling filters had been given the precipitation effluent—the overall oxygen demand reduction being 92 per cent and no nuisance created. The pH value of the supernatant liquid had to be kept below pH 9.6—preferably not above pH 8.5—when applied to sprinkling filters.

Mr. Warrick said that, operating during the summer only, these precipitation plants had given employment and experience to college boys taking chemical and sanitary engineering courses. This had resulted in satisfactory and economical operation.

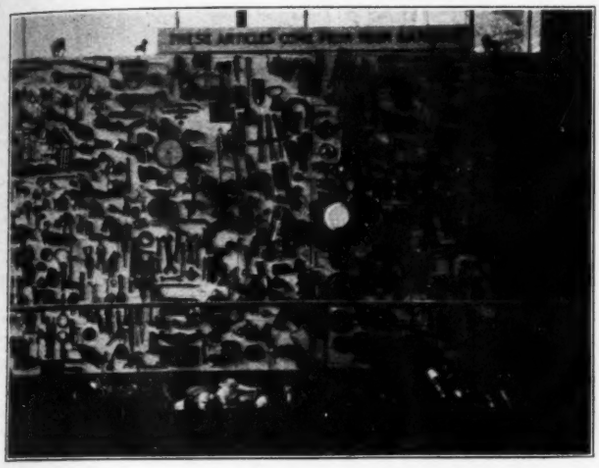


Exhibit "A": A Few "Odds and Ends" Collected in the Indianapolis Garbage Reduction Works

"Selling Sewage Treatment"—GUS. H. RADEBAUGH, Manager Urbana-Champaign Sewage Treatment Works, Urbana, Ill.

Mr. Radebaugh, who has probably sold more municipal authorities on sewage treatment than any other works manager, set forth, in his characteristic and dynamic fashion, arguments and procedure which had proved of value in putting across sewage treatment. There were two primary objectives to be considered in attempts to convince the public and municipal authorities that sewage treatment was a worthwhile governmental function. The first was a systematized educational campaign which could best be worked out with the editors of local newspapers wherein the reasons for and advantages of treatment could be set forth. It was good business to compare the very low cost per capita for sewage treatment with luxuries such as movie tickets or one ticket to a football game. Then, one should also realize that the public had to be taken into the confidence of those proposing sewage treatment. The towns-people should be told the facts and given a chance to attend hearings wherein the proposed sewage treatment program was to be discussed openly. Such familiarization of the public would yield confidence and votes for the required bond issue. Particularly essential was this method of procedure in small or medium sized communities. Then, too, in the early stages, time and patience was a prime requisite in dealing with municipal officials, if successful selling was to result. Mr. Radebaugh in closing pointed out that sewage treatment plant operation on the average in America costs between 11 and 55 cents per capita only. The cost at Urbana had been but 31 cents for the past year with an added $1.43 per capita for interest and bond retirement—the total being less than the cost of a ticket to one football game and compares favorably with an annual cost of $7.50 to maintain the average cesspool serving a taxpayer's residence. Mr. Radebaugh thought the increased interest of the daily press in sewage treatment should be taken greater advantage of and some organized action might well be taken by those interested in seeing our streams returned in part to their original condition. This suggestion he threw out to manufacturers of sewerage equipment and to consulting engineers who, by concerted effort, could do much in the way of forwarding nation wide interest in sewage and industrial waste treatment.

H. C. DELZELL, of Chicago, told how the recent program of "selling" Bloomington, Ind., citizens a sewage treatment plant had been conducted. The new legislation making it possible to finance construction and operation of the plant and interceptor sewers (now under construction) from an issue of revenue bonds and a charge of sewer rental had made it possible for Bloomington to proceed with a bond election for the purpose. The first action was to sell the idea of sewage treatment to the local civic organization—the Chamber of Commerce being the most and the first to sell on the idea of sewage treatment as a means of putting men to work to produce a local asset. Making a sentiment survey by appointed sectional committee members yielded a picture from which the campaign could be mapped and subsequent sales efforts properly directed. Newspaper publicity and arguments, supplemented by hand bills just before election, had been most helpful. He had discovered that the public generally were not sufficiently informed as to the important relationship of sewage works construction to the "Blue Eagle" of the NRA. And there were actually about 6,000 Bloomingtons in America to break the depression if each would do its part in public works construction.

H. F. FERGUSON, State Sanitary Engineer of Illinois, praised the ability of Mr. Radebaugh as "a salesman of sewage treatment to the public" who had been responsible for much of the progress made in Illinois.

"Revenue Bonds and Sewer Service Charges at Bloomington, Ill."—CARL CARPENTER, City Engineer, Bloomington, Ill.

Mr. Carpenter said that the new state law had made it possible for Bloomington to issue revenue bonds to finance construction of sewers and sewage treatment works without increasing the legal debt of the city. Interest, amortization, bonds retirement and operation costs would come from sewer rental. The city of 23,000 population had voted $495,000 to build a 2 mile outfall sewer and treatment works to provide sedimentation, separate sludge digestion and trickling filter treatment at a capacity 2.5 times the present population loading. To cover charges for operation and maintenance only, the actual users of the sewers would bear the burden. The rental for sewer service had been fixed on water consumption or the volume of liquid entering the sewer where the former did not apply. For first 2,000 gals. the charge would be 12.5 cents per 1,000 gals. per month; 10 cents per 1,000 gals. for the next 3,000 gals.; 9 cents per 1,000 for the next 5,000 gals. and so on. In this manner 52 per cent of the users would pay at the rate of 45 cents or less per month—$5.40 per year or less—and 22 per cent of the users would pay only $3.00 per year.

M. W. TATLOCK, Superintendent of Sewage Treat-

ment, Dayton, O., commented on the very reasonable charge of Bloomington as compared to the Dayton charge of $1.25 per month as a minimum.

"Sewer Service Charge Delinquencies"—W. W. MOOREHOUSE, Director, Department of Water Works and Sewage, Dayton, O.

Mr. Moorehouse stated that the Sewer Rental Act of Ohio requires that income from sewer rents be kept apart in a special account and drawn on for operating and maintaining sewers, pumping stations and sewage treatment only. Surplus funds could not be used in

W. D. Hatfield of Decatur, Ill., and C. K. Calvert of Indianapolis—Both in Charge of Sewage Treatment Plants—Have Many Problems of Mutual Interest

making sewer extensions. The combination of the water and sewer departments facilitated the making of charges on the basis of water consumed (minimum sewer rent $1.25 per month) and collection of water bill and sewer rent at one operation—the sewer rent being added to the quarterly bills for water. Unpaid sewer rents were handled in the same manner as unpaid water bills. In 1930 there had been but $22.00 in delinquent accounts out of a total of 48,500 users but in 1932 there had been 465 delinquent accounts, and $1,244 in unpaid bills had been certified to the auditor for collection. During 1933 unpaid water and sewer service charges had been paid, at the rate of $7.50 per month on the average, by work performed by the consumers for the city. On a percentage basis, however, the delinquencies did not appear large—being between 0.5 and 1 per cent, with 0.31 per cent certified for collection by the city auditor.

"Causes and Prevention of Odors at Sewage Plants"—M. W. TATLOCK, Superintendent Sewage Treatment Plant, Dayton, O.

Mr. Tatlock reviewed briefly the chief sources of odors at sewage treatment plants and called attention to the very penetrating and obnoxious odors from floating grease skimmed from sewage, when not taken proper and immediate care of. In flow chambers a grease ring allowed to build up on the tank and channel walls on becoming rancid would be very obnoxious to visitors. The same applied to grease emptied into gas vents if open. At Dayton, skimmings and screenings were promptly incinerated. The gas vents are capped and the gas burned. The sludge had been dewatered on glass covered beds, dried, ground and sold as fertilizer, productive of a very satisfactory income. Mr. Tatlock explained that the public demanded that the Dayton plant be odorless because of its location on the edge of the municipal golf course. Because of hydrogen sulphide production in the flow chambers of the settling tanks some odor complaint had resulted during the first year of operation. Believing in odor prevention rather than odor destruction it had been decided to employ prechlorination of the relatively fresh sewage just ahead of the plant in order to check sulphide production in the tanks by bacterial action. The lime-chlorine process had appealed to them because of reduction in chlorine required and longer sterilization effect of the chloro-products produced by the alkaline hypochlorite formed when the lime emulsion and chlorinator dsicharge mix prior to application. The results had been very satisfactory during the past three summers—only sufficient chlorine being required to produce a residual in the crude sewage but not enough to carry far into the flow chambers of the tanks. Other benefits in addition to odor control had been observed, viz., an improvement in sludge conditions and the tank effluent—the latter being lower in solids content and oxygen demand value.

"The Value of Sewage Plant Operation Reports"—O. M. LEONARD, Director of Department of Sanitation, Frankfort, Ind.

Mr. Leonard enumerated several reasons why operating data and other effects should be recorded in report form by sewage works operators. Such reports should include operating costs and all unusual conditions should be recorded for future use and protection of the operator or the municipality. He believed that plant and operators should be rated on the basis of completeness of operating records and reports. Such records would prove of value in designing or planning improvements or additions to the plant; would serve as evidence in court cases; would encourage improved operation; safeguard the public investment and serve to stimulate competitive operation in order to improve the records.

C. K. CALVERT said that records were important also in budget preparation and were useful for convincing officials of the need for equipment or improvements.

Dr. Rudolfs of New Brunswick, N. J.; and L. F. Warrick, Chief Engineer Wisconsin Department of Health, Have Just Inspected Harry Jordan's Modernized Chlorinating Installation

"Determination of the pH Value of Sludge"—WM. D. HATFIELD, Superintendent Sanitary District, Decatur, Ill.

Dr. Hatfield, in discussing the available methods of determining pH value of sewages and sludges, said that his experience indicated the simple colorimetric method to be the most practical and dependable. Indicator solutions should preferably be bought ready prepared for use from the manufacturer producing the test set in use. The sludge sample should be diluted to produce a supernatant of sufficiently low turbidity to read colors in, but the less dilution beyond that point the more accurate would be the results. He recommended care in sludge sampling to avoid loss of carbon dioxide gas. At Decatur samples of sludge liquor were drawn from the zone above the sludge surface (the reactive zone) with

a pitcher-type pump carrying a rubber suction hose 1.5 inches in diameter. The pH value of such samples would be somewhat lower than that of bottom sludge. He had used the "S.C.D." pH test set with considerable satisfaction. Because of the small volume of liquid required, ease of manipulation and low cost, it was attractive. He had observed no fading of glass color disc standards of the Helige set and the Helige wedge comparator he found to have definite advantages in that it covered a very wide range of pH values with the single indicator solution used in conjunction with it. The simple color chart, showing pH values, which was available from Williams and Wilkins, publishers of Baltimore, Md., for $1.00, he had used considerably and always carried it on field trips.

C. C. LARSON of Springfield, Ill., called attention to the importance of using only a neutral water for sludge dilutions.

DR. W. RUDOLFS of New Jersey said that he had not found the method of taking sludge samples to be overly important if reasonable common sense was employed. He had not observed any serious error resulted from filtration of sludge either after or before diluting it.

C. K. CALVERT of Indianapolis, Ind., said that pH determinations had been advanced a few years ago as the "Peruna" for the water works and sewerage operator. It had been a wonderful tool to guide operators, but nothing more. Used in conjunction with lagooning of sludge, he had found that maintaining a pH of 7.0 in the zone of introduction of fresh solids to the lagoon to be essential if odors were to be prevented. On that score he depended on pH determinations to guide him in sludge lagoon operation.

"Chemical Treatment of Sludge to Facilitate Disposal"—L. H. ENSLOW, The Chlorine Institute, New York City.

Mr. Enslow reviewed recent progress in sludge conditioning by treatment with coagulating chemicals to facilitate dewatering on vacuum type filters and gravity filters. He said that the principle involved was the same, regardless of the separatory device (filter) employed, viz., the freeing of the water held by the suspended solids brought about by adjustment of the hydrogen ion concentration and clotting together of the solids by coagulating phenomena. Sludges would be subject to agglomeration and liberation of free water at an alkaline point and at an acid point on the pH scale. In the alkaline zone there would be a loss of ammonia from the sludge but the filter cake produced would remain free of odor and could be disposed of on land or sludge piles without odor nuisance. An acidic sludge cake could not be piled without odoriferous decomposition resulting and therefore had to be dried for fertilizer, burned or spread on land and plowed under promptly. He listed the several chemicals employed in sludge conditioning and stated that ferric chloride remained the most efficient coagulant at low pH values whereas ferric sulphate or ferric chloride and lime could be used in alkaline conditioning.

In assisting sludge dewatering on sand beds, ferric-chloride had been effective in the proportion of between 2 and 6 lbs. of ($FeCl_3$) to each 100 lbs. of dry solids in the sludge. Alum had been used with success—a higher dosage being required. Ferric sulphate seemed to be intermediate between the two as a conditioner as had chlorinated ferrous sulphate (chlorinated-copperas).

In sludge conditioning activated sludge and mixtures of activated and crude sludges for dewatering on vacuum filters, data from several points had indicated that between 4 and 6 per cent of ($FeCl_3$), calculated on dry solids in the sludge cake would be required. The yield of dry solids per square foot of filter surface had been between 2 and 6 lbs. per hour and the moisture content of the cake between 79 and 82 per cent.

In conditioning digested sludges between 4 and 9 per cent ($FeCl_3$) had yielded 6 to 9 lbs. of dry solids per hour from each square foot of filter area—the filter cake having a moisture content of 76 to 80 per cent. In comparing the ratio of conditioner to solids it must be remembered that much of the organic matter had been converted into gas during digestion and therefore when calculating back to original organic solids or to a per capita basis, the ferric chloride requirement would be very nearly the same, or possibly lower, when dewatering digested sludges. The chemical cost of dewatering digested sludges had been reduced where ferric chloride or ferric sulphate had been supplemented with lime application—allowing a material reduction in ferric salt requirement. Adding about 10 per cent lime made it possible to cut the cerric coagulant dosage about in half —i.e., to about 4 per cent.

In chemical conditioning of sludges the Chicago tests had shown the considerable advantage of a pulping device (hammer-mill) in the line going to the sludge pump feeding the filters. Further, the efficiency of mixing and promptness of delivery to the filter were other highly important factors and the same applied also in conjunction with dewatering on sand beds—a quick mix and prompt delivery being essential.

In dewatering chemically precipitated sludges a very high pH value had appeared most effective except in the Guggenheim process where the sludge cake was incinerated and acid treated to recover the iron coagulant. Winston-Salem, N. C., and Providence, R. I., continued to use lime alone but at Dearborn (employing iron and lime precipitation) ferric sulphate was being added first and thereafter sufficient lime to raise the pH of the mixture to 11.2 or higher. Approximately 3 per cent of ferric chloride or ferric sulphate and 17 per cent of burnt lime had been effective in producing a sludge cake of 85 per cent moisture content at a rate of 8 to 12 lbs. of dry solids per hour per square foot of vacuum filter area. Reduced, however, to pounds of actual sewage solids, the yield would be 4 to 6 lbs. per hour. At Rockville Center, L. I., lime and paper pulp was being employed but operating data was not yet available.

For large plants, it appeared that incineration of the filter cake seemed to be the most practical solution of the problem of disposal and such was the trend of developments at Chicago and Dearborn.

"Mr. Enslow said that the most interesting and important development in sludge conditioning—one productive of coincident reduction of chemicals required and increase of yield by vacuum filters—had been the elutriation process which was now undergoing development by A. L. Genter of Baltimore, Md. In this process the sludge, regardless of its source, was, prior to conditioning, being subjected to a washing with clean water—i.e., elutriation. Experiments at the Baltimore plant had shown that digested sludge when mixed with water, in the ratio of 1 volume of sludge to 1 or 2 volumes of water and the supernatant decanted, could be conditioned with 2 per cent as compared to 4 to 6 per cent ferric chloride required by the unwashed sludge; but the most startling result had been the increase of dry solids yield per square foot of filter area. An unwashed digested sludge giving yields of 6 to 8 lbs. per hour per square foot with about 5 per cent ferric chloride ($FeCl_3$) dosage after elutriation had yielded around 35 lbs. per hour when using about a 4 per cent ferric chloride dosage. The elutriation process when applied to crude solids or activated sludge had produced similar savings and increased yields.

EXPERIENCE WITH ANTHRACITE COAL AS A FILTER MEDIUM FOR WATER SOFTENING

By C. P. HOOVER

Superintendent of Water Purification, Columbus, O.

C. P. Hoover

ANTHRACITE coal has been used as a filter medium at Dallas, Tex., Denver, Colo., Cumberland, Md., and Steelton, Pa., for a number of years and has been reported as giving satisfactory results. However, when the city of Dallas built a second filtration plant, standard filter sand was used instead of anthracite coal.

Recently, Messrs, Homer G. Turner and G. S. Scott, of the Anthracite Institute, and M. A. Farrell of Lehigh University, have been conducting extended laboratory experiments for the purpose of showing the value of anthracite coal as a filter medium and its advantages over sand. These investigators have published a number of articles(1) on this subject recently.

Based on the results of such experiments, the authors have made the following claims for anthracite coal:

1. To expand filter beds 50 per cent, coal requires only about one-half the wash water velocity that is required to expand a bed of sand the same amount.
2. Tests indicate that anthracite possesses greater efficiency than sand in the matter of turbidity reduction. The superiority of anthracite is believed to be due to the angular shape of the particles.
3. Anthracite, because of its lower specific gravity and its angular particle shape, offers a greater bed porosity than does sand. At the same time, due also to its angular shape, it exposes more surface to the floc than does a rounded sand.
4. Due to its specific gravity and to the angular shape of the particles, an anthracite filter bed is more uniform from top to bottom with respect to particle size distribution than are sand beds.
5. These properties combine to permit greater depth of floc penetration with consequent decrease of clogging near the surface. Thus, longer filter runs are obtained, with a given efficiency in the removal of suspended matter (turbidity) from the water. Greater efficiency is obtained because of the larger area of grain surface exposed, and because the increase in particle size with depth is less marked with anthracite than is observed in the case of sand.
6. Laboratory results show that in removing color, odor, turbidity, excess chlorine, and bacteria, anthracite is superior to sand.

A Test of Anthracite at the Columbus Plant

One of the filters at the Columbus water softening and purification works was rebuilt in the summer of 1932, and anthracite coal was used as the filter medium instead of sand. The anthracite coal was obtained from the Herndon Coal Co., Harrisburg, Pa., at a cost of $3.50 per ton, f.o.b. Sunbury, Pa., and the freight rate was $4.97, making the cost delivered $8.47 per ton. The coal weighed, in the wet condition as received, 61 lbs. per cu. ft., and therefore to place a 2-foot depth of the material in the filter, 65 tons of coal were required, at a total cost of $550.55.

There would have been needed 108 tons of sand to equip this filter and the sand would have cost $5.50 per ton delivered in Columbus, making a total cost of $594. Therefore, it cost $43.45 less to equip the filter with coal than with sand.

It was impossible at the time this filter was equipped to obtain ground anthracite of the desired effective size. The best that could be obtained was anthracite with an effective size of approximately 1 m.m. and a uniformity coefficient of 1.6. The anthracite filter has been in continuous operation since August 30, 1932, and during this time has proved to be very satisfactory. The quality of water delivered by this filter as judged by its physical, chemical, and bacterial qualities, has been no different from that delivered by the other (sand) filters.

An examination of the filter, after 13 months of operation, shows that there has been no lumping or cementing together of the anthracite but the material did show considerable incrustation. An acid treated sample showed about 20 per cent loss in weight.

After 13 months of operation, a sample collected from just below the surface showed an effective size of 0.95 m.m. and a uniformity coefficient of 1.2. As already stated the material as received showed an effective size of 1 m.m. and a uniformity coefficient of 1.6, and therefore it is evident that the finer particles of coal have been carried to the bed surface. When originally received the wet coal weighed 61 lbs. per cu. ft. and after drying weighed but 53.6 lbs. per cu. ft. After 13 months of use the dry coal weighs 60.11 lbs. per cu. ft. and the wet coal 64.87 lbs. per cu. ft. When first put in service the maximum wash rate required to float the bed in the anthracite filter was 12 to 15 inches rise per minute, but since the coal has become incrusted a rise of 20 inches per minute can be used.

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(b) "Loss of Head and Backwashing Velocities for Anthracite Coal in Water Filters"—H. G. Turner and G. S. Scott, WATER WORKS AND SEWERAGE, February, 1933.
(c) "Clarification of Water Supplies By Filtration Through Anthracite"—H. G. Turner and G. S. Scott, WATER WORKS AND SEWERAGE, April, 1933.
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Acknowledgment.—The above article has been drawn from a paper presented by the author before the 13th Ohio Conference on Water Purification.

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WATER CLOCKS OF THE EARLY IRON AGE—The Keltic people of the Early Iron Age in Britain (the Druid folk), made use of a clever device known today as a "water clock." Water clocks were thin bronze bowls with a hole in the centre of the bottom. They were floated in a larger vessel of water and sank in a definite length of time. Thus, hour-like intervals could be marked off in the passage of the days.

WATER WORKS IMPROVEMENTS AT WILLISTON, NORTH DAKOTA

By C. KELSEY MATHEWS*

Treatment Plant Serves Triple Purpose

IMPROVEMENTS to the water treatment plant recently constructed at Williston, N. D., are designed to serve three distinct purposes at very little greater first cost than would have been required had the plant been designed for one purpose only. The old settling basins, filters, and pump station structures have been incorporated in the design in a manner which preserves their full value and at the same time has not handicapped the design of the new structures. Other unusual features of the design are double pumping of filtered water; a pressure cover over the new clear well; the housing of the new filters, mixing basins, and clarifier under one roof; and the construction of concrete manholes over all yard valves.

The plant has been designed with the idea that it may be required to perform any one of three phases of treatment in addition to performing its functions in fire protection. The three phases of treatment are as follows:

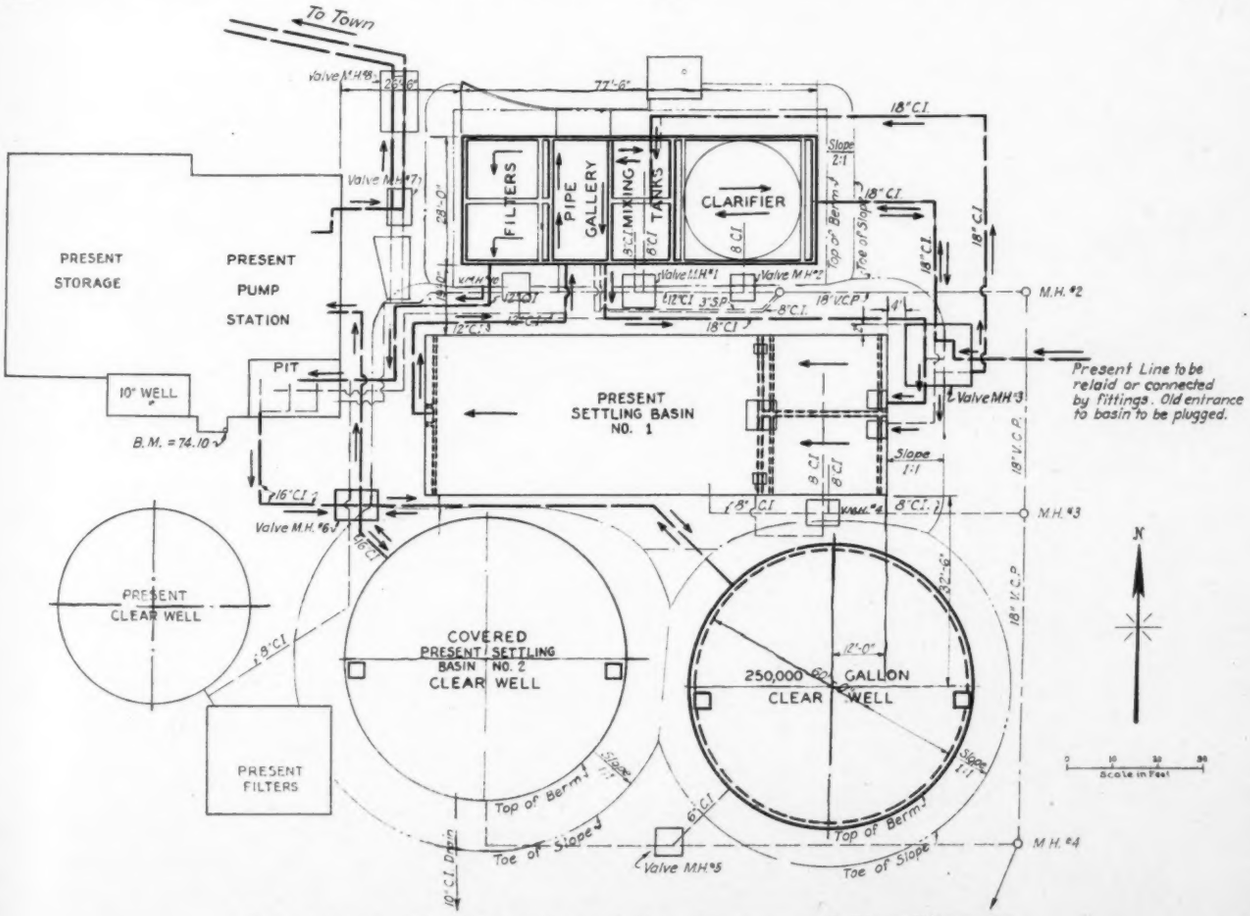
1. Clarification of Missouri River water.
2. Softening of Missouri River water.
3. Removal of sodium carbonate from well water.

The first phase may be accomplished alone or may be accomplished simultaneously with the second phase. The reasons for provisions for this triple purpose are explained by a brief discussion of the history of the plant.

The city of Williston has a population of about 5,000. It is in the northwestern part of North Dakota, on the north bank of the Missouri River about thirty miles below the mouth of the Yellowstone River.

The municipal supply has been obtained from the Missouri River since about 1900 although several attempts to develop a well supply have been made. The river has a tendency to change its channel rapidly and shift from one side of the flood plain to the other. In 1928 it moved from its location near the plant to the other side of the flood plain, causing the abandonment of the original intake. The city at that time constructed the present intake and pump station at the nearest point on the river, approximately one mile downstream from the treatment plant. During this period three wells were constructed on the plant site. The city used the water from these wells during a period of several months until the present intake was completed. One of these wells is maintained as an auxiliary supply anticipating the removal of the river channel from the present intake which will doubtless occur in the near future, inasmuch as the river is rapidly cutting through a bend opposite the intake.

*Burns & McDonnell Engineering Company, Kansas City, Missouri.



General Layout Showing Existing and New Structures and Flow Diagrams

The normal turbidity of the river water is about 3,500 p.p.m., but ranges from about 800 to 10,000 p.p.m. The total hardness ranges from 135 to 340 p.p.m. and averages 200 p.p.m. The average alkalinity is 127 p.p.m. During the spring and summer months the turbidities are high and the hardness is generally below 175 p.p.m. During the fall and winter months the turbidities are comparatively low and the hardness is generally above 200 p.p.m.

Flexible Clarifier and Mixing Chamber Arrangement Provided

The primary purpose of the treatment plant will continue to be the clarification of the river water, but because of the comparatively low turbidities existing during the winter months, partial softening will be accomplished during this period, the intention being to maintain a uniform hardness of approximately 150 p.p.m. throughout the year. The only additional first cost directly chargeable to softening is the installation of a carbon dioxide generator, for neutralization of excess lime. This extra cost amounted to $1,500. Another item of cost which perhaps should be charged partially to softening is the installation of piping and valves for allowing reversal of raw water flow from mixing chambers to clarifier or visa versa, and the return of primary sludge to the mixing tanks to aid in coagulation. The provision for this flexibility in operation, however, was considered advisable even if clarification alone were to be accomplished, so as to allow the clarifier to be used as a grit chamber ahead of chemical dosage for heavy turbidities, or as a primary sedimentation basin after chemical dosage for low turbidities in the raw water.

The well water analysis shows a total methyl orange alkalinity of 858 p.p.m., a total hardness of 343 p.p.m., leaving 515 p.p.m. sodium bicarbonate. This quantity of soda makes the water very disagreeable for domestic use and provision has been made for treating the water to reduce it. There are several chemicals which will accomplish the purpose, all of which are required in such large quantities as to be expensive. It is estimated that the annual cost of chemicals for reducing the soda with alum to 200 p.p.m. would be $13,000 if well water were used exclusively, as against $1,000 for purifying and softening river water. The use of well water is therefore only justified in emergencies. The only additional first cost involved in providing for its treatment was the pipe and valves to connect the well discharge to the raw water inlet to the new plant.

The incorporation of old plant structures in the new plant design involves a principle of design very often overlooked. The general layout plan shows the old structures and their utilization as parts of the new plant. The original structure, built in 1900, was the small circular brick basin which in recent years has been used as a clear well. This is the only structure which has been abandoned in the new design. An additional circular basin was later built and used as a settling basin. The rectangular settling basin was built about 1910. These settling basins were of concrete with wooden roofs. The walls which were above ground level were insulated with weather boarding which was very ineffective in preventing freezing at the extremely low temperatures encountered. Both basins were well constructed and watertight, but were very inefficient settling basins because of short circuiting, the circular basin because of its shape, and the rectangular basin because of poorly arranged inlet and outlet devices and also because of flow around a longitudinal baffle wall. The normal volumetric retention period in the rectangular basin is 10 hours and the depth is 9 feet, which was considered ample and made the basin valuable, therefore, as a settling basin in the new design. The circular basin was considered valueless as a settling basin, but its capacity was utilized in the new design for filtered water storage. Both of these basins have been provided with reinforced concrete roofs and covered with two feet of earth graded as indicated on the layout.

The old filters were constructed in 1914. They were designed for low velocity water wash with air, had no rate of flow controllers and the available head through them was only about eight feet. The total area of the three beds was 300 square feet, being equivalent to a nominal rating of 860,000 gallons per day. It was considered necessary to add two new filters of 500,000 gallons per day nominal capacity each. A tentative design and estimate were made for constructing the new filters as an extension to the old ones, with the intention of installing a clarifier mechanism in the old circular basin, and constructing a new 500,000 gallon clear well near the filters. This method was in harmony with the popular desire to preserve intact every detail of the old structures and to add to and extend them as needed. That this method was false economy was clearly developed in this case as the details of the design were considered. The result was a patchwork scheme and the estimated cost was as great as the actual cost of the separate plan finally adopted. It was decided to leave the old filters without modification for reserve units and to construct the new filters in the location most advantageous for normal operation.

These considerations resulted in the design and construction of the new filters, mixing basins, and clarifier, with continguous walls and all under one roof as shown on the general layout.

Clear Water Well Arrangement Somewhat Novel

The question of a deep clear well for gravity flow through the filters versus pumping from a suction well beneath the filters to a clear water basin at normal ground elevation was answered by a comparison of the annual costs of the two projects. The first cost of the latter scheme plus power cost capitalized at 6 per cent was found to be 50 per cent cheaper than the deep well scheme and was adopted. This decision was further justified by the fact that the old circular basin, having half of the storage capacity necessary, could be thus utilized as clear well storage.

The pumps for boosting the water from the suction sump under the filters were installed in a deep pit in the old pump station which had formerly contained low service pumps for raw water pumping. The wash water pump was also installed in this pit. All of these pumps are below the bottom of the new clear wells and filter sump and require no priming.

The new clear well, constructed adjacent to the old circular basin remodeled as a clear well, and equal to it in capacity, was constructed with its top four feet lower than the top of the circular basin so as to balance the cut and fill around the structures. This required that the top of the new clear well be designed for upward pressure and water tightness to serve under the condition existing when its companion well is full. It involved no extra expense, except for a small amount of extra concrete and steel in the new walls—this because of the fact that an earth cover was required in any case. The value gained is the cost of extra earth "borrow" which would have been required if the two wells had their tops at the same elevation.

Valves Made Accessible

The yard piping was laid in the natural ground and all valves and fittings were set in concrete manholes

whose tops were flush with the finished grade, thus making the valves readily accessible and positive in operation. The total cost of the manholes was about $800 more than roadway boxes would have cost.

A new high service pump of 900 gallons per minute capacity was installed in the old pump room. This pump, together with two 600 gallon per minute pumps already in service, is below the water level in the clear wells when they are full and thereby require no priming. Duplicate vacuum pumps taking suction from the casings of these pumps are installed for priming when the clear wells are at a lower elevation. The high service pumps have a common header from the bottoms of the clear wells. All pumps are motor driven with push button control.

The new filter units are of 600,000 gallon per day nominal capacity each, which capacity will be sufficient for the maximum daily demand anticipated for 1940 without using the old filters except in emergencies.

Mixing and Chemical Feed

The duplicate mixing tanks provide a normal retention period of 30 minutes. Stirring mechanisms are of the suspended paddle type, driven by electric motors through Reeves variable speed transmission units. One duplex dry feed machine is located directly over each tank so that two chemicals may be applied from either machine to either tank.

The sludge pump, for drawing sludge from the clarifier and discharging either to the sewer and/or returned to the mixing tank, is located in the pipe gallery between the filters and mixing tanks.

The clarifier provides a normal retention period of two hours and is ten feet deep. The flow is across the tank. The mechanism is supported on a central column and scrapes the sludge deposited on the circular bottom to a central cone.

The new building is heated with two steam unit heaters supplied by the original heating boiler in the old pump station.

The Western Construction Company of Williston were the general contractors; the E. W. Bacharach Company installed the filter equipment; the Dorr Company furnished the clarifier mechanism and sludge pump; the Hardinge Company furnished the mixing mechanism; the International Filter Company furnished the carbon dioxide generator ;and the Allis-Chalmers Company furnished the pumps and motors. The total cost of the improvements was $65,000.

The Burns & McDonnell Engineering Company of Kansas City, Mo., designed the improvements and were the consulting engineers. Mr. W. H. Robinson, the City Engineer, supervised the construction.

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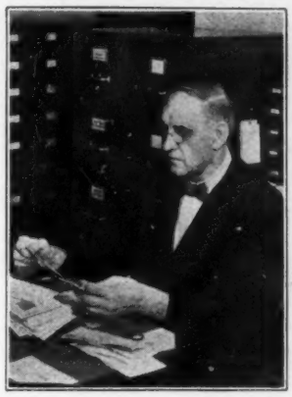
Malcolm Pirnie Deputy NRA Administrator

In our October issue it was reported that Malcolm Pirnie, President of the American Water Works Association, had been made Deputy Administrator of the Public Works Administration (P.W.A.) in charge of the construction industry.

This was in error; Mr. Pirnie is Deputy Administrator of the National Relief Administration (NRA) and not the PWA as reported. His new work is that of supervising the preparation of basic codes for the construction industry and related materials industry of the country.

Edward C. Leible Rounds Out Sixty Years of Service with Indianapolis Water Co.



E. C. Leible

Since 1873 Edward C. Leible has served continuously as an employe and officer of the Indianapolis Water Company. This record of 60 years is believed to establish a record among water supply plants west of the Alleghanies and probably in the United States.

Commemorating Mr. Leible's remarkable service record, his company gave a luncheon in his honor on Saturday, Oct. 28. More than sixty Indianapolis citizens who have been patrons of the public water supply for at least half a century were special guests at the luncheon, together with 103 of Mr. Leible's company associates.

In 1873, when he first began his duties and for nearly 30 years thereafter, Mr. Leible had experience in all branches of building and operating a water supply. For the past 30 years, his duties have been confined to the cashier and treasurer departments—working up to the office of cashier and assistant treasurer which he now holds.

When Mr. Leible first joined the company, the Hoosier capital had only one pumping station, 19 miles of mains, and less than 700 patrons. He has been an active participant in the growth of the plant which now has three main pumping stations with six auxiliary units, 659 miles of important mains, nearly 6,000 fire hydrants, and 70,000 accounts representing 350,000 consumers.

If others can match or approach the service of Mr. Leible, we shall be pleased to hear from readers who will supply the information. This in order that we may give men of such faithful and efficient service the recognition so richly deserved.

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John R. Freeman

John Ripley Freeman, of Providence, R. I., died suddenly on Oct. 6th during the procedure of his selection as John Fritz medalist—this award being the highest engineering honor conferred jointly in the fields of engineering, by sixteen past presidents of the four National engineering soccieties.

Mr. Freeman, who was born at West Bridgeton, Me., July 27, 1855, graduated from the Massachusetts Institute of Technology in 1876. He became president of a group of fire insurance companies at Providence in 1896. Mr. Freeman was a member of the Burr-Hering-Freeman commission on water supply for New York City and also of the President's commission to investigate special problems of the Panama Canal. He was a past president of the American Society of Mechanical Engineering and of the American Society of Civil Engineers.

As John Fritz medalist the award to be conferred posthumously characterizes Mr. Freeman as having been—"engineer pre-eminent in the fields of hydraulics and water supply, fire insurance economics and earthquake effects."

THE 13TH OHIO CONFERENCE ON WATER PURIFICATION*

THE 13th Annual Ohio Conference on Water Purification held in Findlay, O., on October 17th and 18th, with a registration of 110 and an attendance approaching 150, established a new attendance record.

Officers elected for the ensuing year were:

Chairman—James M. Montgomery, Piqua, O.

Vice Chairman—Mathew M. Braidech, Cleveland, O.

Secy.-Treas.—Frank S. Taylor, Defiance, O.

Executive Committee—N. J. Hummason, Elyria, O.; John R. Lower, Bucyrus, O.

Algae as Water Softeners

At the annual dinner, PROFESSOR R. C. OSBURN of Ohio State University, told the conference of some of the observations and findings made during a biological survey of the western end of Lake Erie in which no less than 380 kinds of plankton algae were identified. High nitrogen content of the water at spots had been conducive to vigorous plankton growths which created the so-called "water-blooms"—the lake sometimes resembling pea-soup. In Lake Erie diatoms had been the chief offenders and the intense "blooms" followed the nitrogen release due to decomposition of the bodies of billions of may-flies along the shore lines. The algae had been responsible for marked increases in the pH value of the water through a breaking down of bicarbonates, in normal carbonates in order to make use of the carbon in the half-bound carbon dioxide. Thus, by producing and precipitating calcium carbonate, algae assumed the role of water-softeners. Remarking that it was the plankton content of waters which made fish life so abundant in the shallow waters of Lake Erie,

James M. Montgomery, Director Public Works, Piqua, O., and Chairman of the Conference

Thos. H. Tristam, Superintendent Filtration, Lorain, O., Retiring Chairman of the Conference

Professor Osburn shocked his listeners by commenting that "fishes would starve and smother in waters passing through the hands of the water purification chemist."

"Ohio's Sanitary Improvements in the Public Works Program"

On the last day of the conference, F. H. WARING, Chief Engineer of the State Department of Health, presented a review of the remarkable progress made in Ohio in procuring sanitary improvements in connection with the Public Works Administration program. Mr. Waring said that ever since April 1 of this year the Engineering Division of the Health Department had been devoting largely its entire attention to stimulating sanitation projects as a measure of unemployment relief and a means of catching up on normal water works and sewerage developments stopped by the depression. In this activity, six engineers of his staff and he himself had been constantly at work for the past 7 months without vacation. There had been made 250 visits to municipalities followed by 600 office conferences and the net result was that application for funds had been filed for 193 projects to cost $45,000,000 and there were now 80 additional projects to cost $16,000,000 well along in the matter of preparation. The total would be 273 projects to cost $60,000,000. There would be 57 new water supply systems and 25 new purification plants in the state.

Findlay's Water Softening Plant Employs Lime and Zeolite to Produce a Water of any Desired Degree of Softening

In Columbus, Mr. Waring said, there were now 8 examining engineers reviewing applications for the P. W. A. State Engineer. So far, 65 applications had been approved and forwarded to Washington and 16 have received final approval for which $18,000,000 has been allocated. Securing of grants had been simpler than procuring loans. Use of revenue bonds for financing self supporting projects has proved to be the most popular method of financing and had been encouraged by the P. W. A., and 94 municipalities plan to use the method. The Administration had made a ruling recently which allows inclusion in the "design" of water works betterments, such appurtenances as hydrants, house service pipe and meters. Mr. Waring also called attention to the fact that where a grant was being applied for, it was not necessary to supply the information required in P. W. A. Circular No. 2.

In a later report before the Ohio Conference on Sewage Treatment, Mr. Waring said that 15 new sewerage systems were to be built and extensions in 29 cities would cost $18,000,000; that there would also be built 15 new treatment plants to cost $11,500,000.

ROBERT ALTON, Sewerage Engineer of Columbus, O., called attention to the fact that every city was to be taxed approximately $4.00 per capita to supply the P. W. A. funds needed to cover the allotments of grants. That being the case, any city not procuring grants to the extent of its population times the $4.00 tax per capita would be the losers thereby. That money would go elsewhere.

Technical Sessions

The technical sessions were opened with a report of the Committee on Standard Methods of Analysis which

*The Seventh Ohio Conference on Sewage Treatment held in Findlay, O., on October 19th and 20th will be reported in our December issue.—Editor.

had during the year been trying Cyanide-Citrate Agar for making direct coli readings on this solid plate media. J. S. GETTRUST, as chairman, reported on results obtained and comments of committee members with respect to the practicability of the media for routine plant control. The chief objection to the cyanide-citrate media seemed to be that differentiation between b-coli and b-aerogenes was difficult and required too much speculation or personal judgment. The conclusion of the committee was that the media possessed value and merit, but was not adaptable for routine tests in practical plant operation in representative Ohio plants.

CLARENCE BAHLMAN and C. E. EVANS, of Cincinnati, O., presented a bibliography covering American literature on water purification topics for the year 1933

John S. Gettrust, Superintendent Filtration, Akron, Ohio

Mathew M. Braidech, Cleveland, O., Vice Chairman

and made reference to what they had considered to be outstanding articles incorporated in their bibliography. It was the consensus of opinion of the members of the conference that the valuable work of this committee in presenting an annual bibliography should be continued.

An Interesting Soap Described and Demonstrated

MR. BAHLMAN exhibited a sample of a new type of soap-powder which had the interesting property of forming a satisfactory lather in very hard water regardless of the very small quantity of the detergent added. The explanation given by him was that the usual fatty acids precipitated in hard waters had not been used in making this improved product. Neither would alkali or acid waters precipitate the new soap which was the sodium salt of an alkyl sulphuric ester. The product demonstrated carries the trade name "Orvus" and is being produced by the Proctor and Gamble Soap Works at Cincinnati, O.

C. P. HOOVER of Columbus commented also on this new product, which he had found to react differently with calcium and magnesium salts, making it practicable to standardize, a solution of the material for use in determining the approximate magnesium content of waters.

"Zeolites and the Zeolite Process of Water Softening"—C. P. HOOVER, Chemist in Charge, Water Softening Plant, Columbus, O.

No attempt will be made to adequately report the exhaustive paper prepared by Mr. Hoover to cover the historical and practical developments in the "Zeolite Process of Water Softening." In a brief abstract of the paper he reviewed the history of patent litigation just settled finally in 1932. One of the most important factors to be considered in the choice of zeolites, he said, was their relative durability and that was now the characteristic of zeolites receiving major attention. Durability tests were conducted by placing the material in a ball-mill with water and determining the wear of the zeolite by making turbidity measurements of the water removed after operating the ball-mill a standard number of revolutions.

"Water Analysis in Water Purification Control"—R. D. SCOTT, Chief Chemist, State Department of Health, Columbus, O.

Mr. Scott's paper constituted a series of comments on the procedures of chemical analyses which appear in the Standard Methods of Analysis of the A. P. H. A. It pointed out some of the weak spots in the Standard Methods and discussed the more important sources of difficulty and possibilities of error in a few of the methods. For example: in determining total iron, all organic matter present should first be destroyed if appreciable error was to be avoided. In developing the color with thio-cyanate, the addition of the exact quantity of acid and indicator solution to each sample was essential to accuracy. In determining the carbon dioxide content of waters the titration endpoint would be pink but in procuring check results much depended upon the amount of phenolpthalin indicator added to the sample. He felt that methyl orange was inferior to methyl red or erythrosine as indicators in alkalinity titrations because the change of orange to pink was at a too low pH i.e. pH 4—whereas methyl red changed at pH 4.9 and was thereby more practical in his opinion. The total noncarbonate hardness as determined by the soda method did not give all of the incrustants present in every water and he warned that in determining calcium and magnesia gravametrically it was essential to first remove all iron and aluminum from the sample.

H. E. JORDAN, Chairman of the A. W. W. A. Committee on Standard Methods, called attention to a regrettable typographical error in the new edition of Standard Methods. In the method for iron determination the volume of 3 Normal hydrochloric acid specified should be but 0.5 cc. and not 5 c.c. as it appears in the procedure. He also referred to the possible nitrite interference with the orthotolidin test for available chlorine. To avoid color production by nitrite the contact period

G. H. Strickland, Superintendent Filtration, Windsor, Ont.

Otto C. Gohlke, City Engineer and Superintendent Water Works and Sewerage, Findlay, O.

after adding ortho-tolidin could be reduced to a few minutes and the color, allowed to develop only in the dark, with rapid comparison with the standards thereafter.

C. P. HOOVER commented on the error likely to occur in a determination of hardness and incrustants in a mixture of zeolite softened water and lime softened waters

such as is now frequently dealt with. Under the circumstances the only accurate method is to determine the values on each water separately and knowing the ratio of mixture calculate the incrustants and carbonate hardness in the mixed waters.

New Development in Water Analysis

"Spectrographic Analysis of Waters"—M. M. BRAIDECH, Senior Chemist, Baldwin Filters, Cleveland, O., and F. H. EMERY, Spectrographer, National Smelting Company, Cleveland, O.

Mr. Braidech recounted recent developments in water analysis in which the spectroscope had been used. The possible value of such a delicate method of determining qualitatively or semi-quantitatively the many elements present in water, even in minute quantities, had been brought to his attention by the work of Mr. Emery in examining aluminum dross for traces of fluoride, arsenic, etc., by spectrographic methods. Later applied to the solids from evaporated water samples little suspected contents of waters had been uncovered. The dry solids in small quantity when placed in the electric arc being vaporized and subjected to light rays passing thereafter through a prism produced the well known spectra bands which were subject to photographing to produce a spectrograph. The method was therefore as rapid as it was sensitive, requiring but 30 minutes to secure the spectrograph. Further, the method was not subject to any personal equation in as much as the position and width of the spectra bands told the story when comparing the spectrograph of the sample with those made from synthetically prepared specimens of mixed salts of known composition for control. The spectrographs of waters from 10 cities had revealed the presence of fluorides and other equally rare and little suspected constituents.

At this point Mr. Emery told of the actual analyses of waters from ten Ohio cities—many being made on the waters before and after filtration. The raw water at East Liverpool had shown the highest quantities of manganese, lead and zinc but filtration had removed all three. The Marion water contained the highest quantity of strontium whereas the Findlay water contained

F. P. Fischer, Wallace & Tiernan Co., Columbus, O.

R. W. Furman, Superintendent Filtration, Toledo, Ohio

traces of gold. In the Cleveland unfiltered water, every known element had been found. Filtration had in all cases removed lead, zinc, iron and manganese but not strontium or fluorides.

The Value of Water Works Employees' Organizations

THOMAS TRISTRAM, Superintendent of Filtration at Lorain, Ohio, Chairman of the Conference, with probably the longest record of continuous service in the water purification field to his credit of any member of the group, told of the value derived from "The Lorain Organization of Water Works Employes." He said that such an organization had been productive of loyalty, efficiency and most of all friendliness between the men who had to work together. Amongst other things "passing of the buck" or placing the blame for failures on brother employes had been eradicated and every fellow "stood his own" and endeavored to see that operations on his shift would create no hardship on the fellow taking the following shift. The personnel of the water works organization at Lorain had been free of political henchmen and therefore had not suffered during the many years of political changes at Lorain. The organ-

W. C. Lawrence, Superintendent Filtration, Cleveland, Ohio

Gale Dixon, Consulting Engineer, Youngstown, O.

ization had in nowise been patterned after an employes' union but had none the less created strength, a pull-together spirit, and a greater feeling of security.

"Filter Plant Operation at Windsor, Ontario"—G. H. STRICKLAND, Superintendent of Filtration, Essex Border Utilities Company, Windsor, Ontario.

Mr. Strickland, who has charge of the 25 m.g.d. filtration plant serving Windsor and continguous municipalities, said that water purification men should derive satisfaction from the fact that in the face of the lowering of standards generally during the past few years water purification practices had not been neglected, instead there had been a constant improvement and a raising of standard of the finished water, in order that the public might have the best product obtainable at whatever expense the improvement might entail. In recounting some of the developments at the Windsor plant which had improved plant operation and others which had not lowered the standard of product but had brought about reduced operating costs, he had found that whenever the raw water had a turbidity under 30 p.p.m. the alum requirement could be reduced by about one-half by intermittent application.

This advantage he thought to be due to the fact that a good floc was produced which intermingled with the uncoagulated water following it into the basin and the overall result was better clarification and less floc reaching the filters. At turbidities of 10 p.p.m. or less the alum could be on for 30 minutes and off for 30 minutes. Above 10 p.p.m. and up to 30 p.p.m. turbidity, alum had to be applied for 40 minutes and off but 20 minutes of each hour. At higher turbidities the intermittent application had not proved satisfactory.

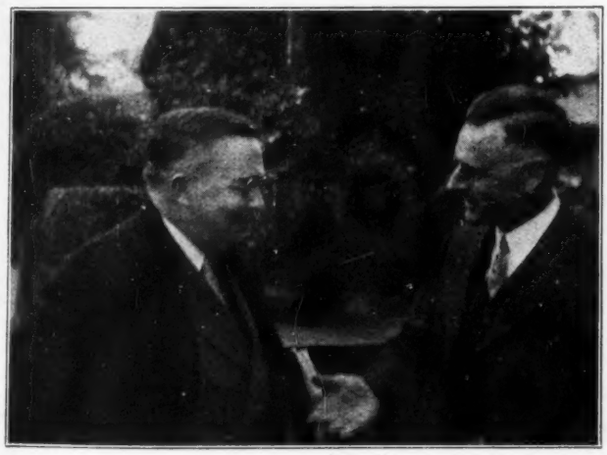
Prechlorination of the raw water had been practiced for several years with a material improvement in coagulation resulting and a consequent lowering of coagulant requirement by about 35 per cent; sand bed condition had improved and wash water requirement had been cut in half. The rate of wash, at 18 inch rise per minute,

had been returned to after having tried rates up to 30 inches per minute without benefit. To improve washing efficiency the sand level had been raised to 18 inches below the trough edges with good effect. They had found the use of ammonia effective in elimination of complaints of "too much chlorine" from consumers and the value of ammoniation had been thus demonstrated to their satisfaction. Adequate records covering operations had been of material help in reducing operating costs without lowering efficiencies and he wished to stress the value of careful keeping and a study of operating records.

Messrs. Braidech and Lathrop complimented the author on his accomplishments at Windsor. Mr. Lathrop remarked that Mr. Strickland had been attending the meetings of the Ohio Conference for several years and it was a pleasure to have him present to them such an interesting paper on Canadian experiences.

"Chemistry Involved in Alum Treatment in Water Softening"—J. M. MONTGOMERY, Director of Public Works, Piqua, O.

Mr. Montgomery, Chairman-Elect of the Conference, in discussing the reactions involved in alum coagulation said that at low pH values alum produced basic sulphates and at very high pH the tendency was to produce aluminate of calcium rather than the hydroxide which was formed at about the neutral zone—(pH 6.5 to 7.5). He said that there was no one best pH value for efficient coagulation because the concentration of anion, such as sulphate (So4) or chloride (Cl) would widen the zone of best coagulation. In assisting coagulation during softening, the use of alum with the excess lime process had little value because the magnesium hydrate produced had a high clarifying value and furthermore calcium aluminate would be produced. From experience he had found that where ordinary softening is involved, more effective use of the alum and economy could be secured by adding it, with thorough dispersion insured, ahead of the softening chemicals rather than simultaneously with or after their addition as was the more common practice. In softening surface waters by the excess lime process special arrangements would be required to properly treat the turbid water during flood stages. During such periods the excess lime process would have to give way to coagulation and clarification with modified softening resulting.



Harry Jordan Hears F. H. Waring Tell How Successful He and His Staff Have Been in Getting Public Work in Ohio Under Way. (See Details in This Report)

"Question Box" Discussions

(T. R. Lathrop presiding)

"Specifications Covering Water Works Chemicals" —M. M. BRAIDECH.

Mr. Braidech had made a survey to determine which Ohio plants employed specifications and laboratory analyses in purchasing water works chemicals. Replies from 32 plants indicated that 11 different chemicals were being used in water purification and 47 per cent of the plants replying purchased on specification. These plants used annually 8,400 tons of alum, 275 tons of chlorine, 40 tons of activated carbon and 10 tons of ammonia or sulphate of ammonia.

Geo. N. Schoonmaker and Harvey P. Jones of Toledo, O., Designers of the Findlay Water Softening Plant and Sewerage Treatment Works

Mr. Braidech reviewed the report of the A. W. W. A. Committee on Specifications for Chemicals of which he is the chairman. He reported that 18 chemicals had been covered already in a preliminary draft.

In a discussion as to the best specifications to apply in purchasing activated carbon, it appeared that so far the method of Baylis in determining the phenol adsorption value together with the threshold taste and odor test of Spaulding, were the best tests available. Mr. Furman of Toledo felt that from his experience it was doubtful that a single specification for carbon would fit for all conditions and Mr. Braidech added that probably the rate of adsorption would be as important for some conditions as the total capacity of the carbon.

In using powdered carbon one member warned against mixing it with burned ground lime in dry feeders. A mixture of 35 pounds of quick lime and 180 pounds of carbon had actually caught fire in the hopper of the machine.

N. J. Hummason, Superintendent Filtration, Elyria, O., Member Executive Committee

"Anthracite Coal as a Filter Media" — C. P. HOOVER. Mr. Hoover referred to the research conducted by the Anthracite Institute and published in WATER WORKS AND SEWERAGE for February, April and September, 1933. He related his own experiences with one anthracite filled filter at the Columbus plant which had been in operation for more than a year. The anthracite used had been fairly coarse (1 m.m. effective size and uniformity coefficient of 1.6) but had proved very satisfactory in that the quality of water from the unit had

been no different in any respect to that from the sand filters. The anthracite had not lumped or cemented together after 13 months of service alongside the sand filters. There was some incrustation of the grains, however, and that amounted to a 20 per cent loss in weight when acid treated. The top layers had an effective size of 0.95 m.m. and uniformity coefficient of 1.2.

When first placing the anthracite filter in service a wash water rise of 12 to 15 inches per minute floated the bed to the point of loss of anthracite. The incrustation had raised the gravity of the material and now the full wash of 20 inch rise was required to float the bed properly. The coal was wet when received, weighed 61 pounds per cubic foot and the entire 65 tons to equip the filter, cost $550.55 including freight to Columbus. Sand (108 tons) to equip it would have cost $594.00.

PHILIP BURGESS, Consulting Engineer, Columbus, O., reported on a recent adaptation of anthracite in an iron removal scheme developed by him for an industrial plant at Chillicothe, O., in which the water had been sprayed over a contact filter 7 feet deep at a rate of 3 gals. per square foot per minute. Experience with other materials had shown them to become cemented together by the iron removed, whereas the anthracite had remained free of the difficulty although the unit had been removing 8 p.p.m. of iron satisfactorily.

Interesting Observations Concerning B. Coli in Filter Effluents

CLARENCE BAHLMAN reported on the appearance of b. coli in the filter effluent at the Blanchester plant employing ferrous sulphate and lime coagulation. In the presence of as much as 10 p.p.m. caustic alkalinity 23 per cent of the filter effluent samples showing gas had yielded b. coli on confirmation. The filters had been operated intermittently with relatively long periods of shut down.

P. J. O'CONNOR reported that the use of pre-ammonia chlorine treatment at the Warren filter plant had for some months given a filter effluent free of b. coli when suddenly these organisms had begun to appear in the effluent although absent in the applied water on the top of the filters. Increased dosages of chlorine and ammonia had not to date corrected the trouble. The organisms seemed to be coming from the filter bed. Attempts to sterilize the bed had not proven effective. Although between 0.45 and 0.7 residual chlorine could be found on top of the filters none appeared in the effluent.

It seemed to be the general opinion of discussors that it was a case of unloading of dirt from the filter bed and the corners of the filter box which would eventually work itself out.

Mr. Braidech said, that they at Cleveland were planning to apply heavily chlorinated wash water for the purpose of cleaning the filters of accumulations and slime.

Experiences with ferric chloride as a coagulant at the Lima filtration plant was reported by E. E. SMITH, Superintendent of Filtration at Lima. The results had not been conclusive because of the difficulties met with in feeding the corrosive ferric salt. Less ferric chloride seemed to be required than alum but the price being so much higher the economy was in favor of alum and likewise handling of alum was less difficult.

In WATER WORKS AND SEWERAGE for December there will appear a report covering the 7th Ohio Conference on Sewage Treatment which was held at Findlay on the two days following the Conference on Water Purification.

Association Meetings Scheduled

Nov. 8—**New England Water Works Association.** Luncheon, meeting. Hotel Kenmore, Boston, Mass. Secretary, F. J. Gifford, Tremont Temple, Boston, Mass.

Nov. 9-11—**Short School for Water Works Operators.** Georgia School of Technology, Atlanta, Ga. Comptroller, W. H. Weir, State Dept. of Health, Atlanta, Ga.

Nov. 13-15—**North Carolina Section A. W. W. A. and N. C. Sewage Works Association.** Hotel Vance, Stateville, N. C. Secretary, Prof. H. G. Baity, University of North Carolina, Chapel Hill, N. C.

Nov. 16-18—**Virginia Water and Sewage Works Association.** Hotel Warwick, Newport News, Va. Secretary, H. W. Snidow, Asst. Engr. State Dept. of Health, Richmond, Va.

Nov. 16-18—**Iowa Sewage Treatment Conference.—Iowa Wastes Disposal Conference.** Joint meeting. Iowa State College at Ames, Iowa. Secretary, L. J. Murphy, Ames, Ia.

Dec. 28—**New York Section A. W. W. A.** Place of meeting not yet selected. Secretary, R. K. Blanchard, 50 East 42nd St., New York City.

Jan. 16—**New York State Sewage Works Association.** Hotel McAlpin, New York City. Secretary, A. S. Bedell, State Dept. of Health, Albany, New York.

Jan. 17-19—**American Society Civil Engineers.** Headquarters, Society Building, New York City. Secretary, Geo. T. Seabury, 33 West 39th Street, New York City.

Mar. (1934)—**Kentucky-Tennessee Section A. W. W. A.** Knoxville, Tenn. Secretary, F. C. Dugan, State Department of Health, Louisville, Ky.

April (1934)—**Southeastern Section A. W. W. A.** Augusta, Ga. Secretary, W. H. Weir, State Department of Health, Atlanta, Ga. (Exact date later.)

Dec. 6-7—**Indiana Section A. W. W. A.** Hotel Anthony, Fort Wayne, Indiana. Secretary, C. K. Calvert, 1902 N. New Jersey Avenue, Indianapolis, Ind.

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W. W. Horner Establishes Engineering Firm

W. W. Horner, for several years Consulting Engineer to St. Louis, Mo., Dallas, Texas, and other cities, and well known for his past work, has recently announced the opening of an office for the practice of engineering. As an associate in his consulting practice, Mr. Horner will have Mr. H. Shifrin, former Assistant Chief Engineer of Sewers and Paving at St. Louis.

Mr. Horner is widely known for his work as Engineer in Charge of Sewerage and Chief Engineer of Sewers and Paving at St. Louis from 1914 to 1933, during which period important sewerage projects have been consummated. He is a past president of the American Society of Municipal Engineers, a Director of the American Society of Civil Engineers, has served as chairman of numerous important committees and now is serving as member of the Board of Technical Review of the Public Works Administration.

Mr. Horner's new offices are located in the International Office Building, 722 Chestnut St., St. Louis, Mo.

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An Acknowledgment

R. W. Haywood, Jr., author of the article, describing "The New Filtration Plant of Easton, Pa.," which appeared in WATER WORKS AND SEWERAGE for October, requests that we acknowledge, in his behalf, the source of the excellent photographs used for illustrating his article. These photographs were made available to Mr. Haywood through courtesy of the Ingersoll Rand Company of Phillipsburg, N. J., who had the lot made at the time of photographing the pumping equipment which they had supplied for the new plant.

THE COST OF DRYING SLUDGE ON SAND BEDS

By DONALD F. IRVING

Engineer,
Oliver United Filters, Inc., N. Y.

D. F. Irving

THE greater part of sewage solids must be disposed of in the form of waste sludge. These solids may be in the form of crude or activated sludge, both putrescible materials, or the solids may have been reduced to a non-nuisance producing digested sludge as is usually the case in present day practice.

Other instances occur such as the sludges produced in chemical precipitation processes. A further classification embraces sludges that are dried for use as a fertilizer-component and still others, after dewatering, are discharged as waste material.

At present, by far the greatest output of sewage sludge is drained on sand-beds until dry enough to remove as waste material, or for use as a fertilizer component. This method requires large areas for the drainage beds. It is not a continuous operation and the inconveniences due to such features have often been cited in articles published on the subject.

Advancing progress in sanitation has brought many useful tools to the sewage-disposal plant operator and since the sewage flow itself is continuous, equipment and processes of continuously operating types offer distinctive advantages in sewage treatment practice. Considerable progress has been made recently in perfecting continuous sludge-filtration processes and equipment and it was for the purpose of gaining a true comparative analysis of sludge-dewatering methods and costs that the data in this article were procured from efficiently operated sewage-treatment plants at representative points in the United States. In view of the scattered and incomplete published data on the subject of sludge-dewatering and costs of sludge-disposal, the findings are here reproduced for the benefit of those interested in this subject.

Making the Cost Survey

The findings are based on a survey of recorded costs incurred by well operated plants of various sizes in different parts of the United States where sludge digestion and dewatering on sand beds is practiced.

The data supplied in each instance was procured from officials in responsible charge of the sewage treatment plants in question. The plants involved range in size from small ones serving 25,000 people to those serving several hundred thousand.

As cost-data were of chief interest, the information sought included:

1. Type of sludge-beds (open or glass-covered).
2. Bed area used per capita of contributing population.
3. Dry weight of sludge in pounds removed daily per square foot of bed-area. (A yearly average figure.)
4. Weight of dried sludge when removed from beds, in lbs. per cu. yd.
5. Actual construction costs of completed beds per sq. ft. of area.
6. Total costs, including fixed charges and amortization.
7. Current charges for operation and maintenance of beds and disposal of sludge.

A careful compilation and study of the data supplied brought out the fact that sand-bed drying is not as inexpensive a process as it is usually thought to be. Furthermore, that sludge may be dewatered by continuous filtration on vacuum filters at an over-all cost that is frequently less than that incurred by sand-bed operation, and in all but the smaller plants, at a comparable cost. (See Table I.)

Always of importance, low fixed charges and first costs are especially important today, and may be the decisive factor in obtaining consideration when loans are being sought for public-works construction purposes. Cost-calculations are affected by the prevailing rates in the bond market at the different periods when the various plants were built and also by the differing costs of loans to the various communities in accord with their varying financial rating.

Computation of Costs

It seemed advisable to choose a coupon-rate, (which, if placed at less than par, should include discount and marketing expense) representative of a reasonable average figure for computing purposes. To this had to be added a figure for amortization, preferably based on annuity methods, with reinvestment assumed. The figure chosen is therefore an arbitrary but fair one, but if some other rate is felt to be preferable, it may be substituted in the computations reproduced here as illustrations under the heading "Examples of Procedure Followed in Computation of Costs."

Obviously, fixed charges per ton of dry solids in the sludge are higher in the case of sludge-beds than for continuous filters. Depreciation charges form a part of the costs under the sub-heading of "upkeep" or "maintenance" and these are larger than is usually supposed. Sludge-beds may be either open or glass-covered types; the latter incurring a considerable extra first cost for the "glass-overs," together with the higher upkeep arising from hail-insurance, repainting, glass-replacements, etc.

Probably it is not generally realized that while the covered beds incur these extra costs, for the sake of drying independently of weather conditions, that the open beds cause a large additional expense because storage of wet sludge, during the season of bad weather when open-bed drying is not practical, must be provided in many instances in lieu of glass-covers. Inquiry on this point usually reveals a substantial outlay for large sludge storage capacity in some form or other, and if charged in as an adjunct to sludge beds, as it properly should be, the fixed charges on open-bed installations are proportionately increased.

Operating cost figures were obtained from data collected during the Fall of 1932 and represent, in general,

TABLE I.

Location of Plant	Dried Sludge (Tons per year) Dry Solids	Operating Costs Total	Operating Costs Per Ton	Fixed Charges Total	Fixed Charges Per Ton	Total Cost (Per Ton) Dry Solids
North	1,814	$2,617 453(1) $3,070 Total	$1.69	$4,428	$2.44	$4.13
Central ...	2,661	$5,144 979(1) 266(2) $6,389 Total	$2.40	$9,954	$3.74	$6.14
South	868	$ 525 811(1) $1,336 Total	$1.54	$2,696	$3.10	$4.64
South	803	$1,686 200(1) $1,886 Total	$2.34	$1,640	$2.04	$4.38
East	851	$1,846 126(1) $1,972 Total	$2.31	$1,523	$1.79	$4.10
East Coast.	6,287	$23,666 Total	$3.76	$23,297	$3.70	$7.46
*Central ..	2,100	$4,452 1,736(1) 2,658(3) $8,846 Total	$4.21	$11,830	$5.63	$9.84

*The only plant in the group which has glass covered beds.
(1) Cost of new sand required for resanding beds.
(2) Haulage of dry sludge.
(3) Upkeep of glass covers.

EXAMPLES OF PROCEDURE FOLLOWED IN COMPUTING COSTS

PLANT (A)—Glass Covered Beds

Dry wt. of sludge removed during year.....2,100 tons
Installed cost of drying beds.....$144,270

Fixed charges (at 8.2%)..... $11,830 = $5.63 per dry ton
Operating costs $4,452
Resanding charge..... 1,736
Repainting glassovers..... 2,658
$8,846 = 4.21 per dry ton

Total $9.84 per dry ton*

Wt. per cu. yd. of removed sludge.....1,187 lbs.
Wt. per cu. yd. of dry solids removed..... 423 lbs.
Moisture content of removed sludge.....68%

*The following year (1932) 1,850 tons removed for $9.24 per ton.

PLANT (B)—Open Beds

Dry wt. of sludge removed during year.....6,287 tons
Installed cost of drying beds.....$284,113

Fixed charges (at 8.2%).....$23,297 = $3.70 per dry ton
Operating costs ..... 23,666 = 3.76 per dry ton

$7.46 per dry ton

Wt. per cu. yd. of removed sludge.....1,800 lbs.
Wt. per cu. yd. of dry solids removed..... 410 lbs.
Moisture content of removed sludge.....77.2%

working conditions prevailing during the previous year.

Construction costs of the various beds are affected to some extent by the prevailing labor and market conditions during the respective years of their installation; no attempt has been made, however, to evaluate this factor, in view of the fact that it would not make important changes in the total costs as computed herein.

The item of fixed charges is computed by using 4½ per cent interest rate on the first cost, plus 3.7 per cent of the same figure to cover amortization, based on the annuity method of retirement with reinvestment assumed.

In certain cases, this resultant 8.2 per cent average rate used in computing fixed charges may differ somewhat from the actual figures appearing on the cost records kept by the respective cities. The 8.2 per cent assumed herein has been employed to provide a common basis of direct comparison. As a matter of fact, in a published article(1) reporting costs of sludge disposal at one of the plants listed, the cost per ton was $2.30 more than the figure calculated on the above basis and shown in Table I. Upon analysis it was found that a high rate of amortization of beds had been responsible for a high fixed charge, and the difference in total cost observed.

One point seems established, i.e., that the total cost of sludge-bed operation, per ton of dry solids produced therefrom, is equal to or higher than the cost of dewatering on modern continuous sludge filters, even in the face of allowing but a 15 year amortization period in filter-cost calculations as compared with 20-year period for sand-bed costs. In nearly all cases the cost for drying on sand-beds exceeds that found by demonstration at Baltimore, Md.,(2) wherein sludge dewatering was effected with vacuum filters at an over-all cost of $4.22 to $4.66 per ton of dry solids involved.

The data collected on the cost of sludge-drying, presented here in tabular form, (see Table I), taken together with "Examples of Procedure Followed in Computation of Costs," will enable the reader to draw his own conclusions from the recorded facts.

Future of Sludge Disposal

Much work has been done already in the direction of sludge incineration. Extensive trials give indications that a simple and practical type of dryer has now been perfected which will steadily dry sludge-filter cake from continuous filters without producing an odor nuisance. The dried product burns readily on ordinary grate-bars and supplies the heat required for its own drying, or the dried sludge can be used as a component of fertilizer to whatever extent such practice may in part or in whole prove a profitable alternative to incineration.

Efforts of various workers in this field have resulted in definite advances in sludge disposal which were not proven or thought practical as recently as two years ago. Mechanical dewatering and incineration of sludges are methods found among such developments.

REFERENCES

(1) "Sludge Drying Beds, San Antonio Sewage Treatment Plant"—W. S. Stanley, WATER WORKS AND SEWERAGE, April, 1933, p. 123.

(2) "Dewatering Sludge by Vacuum Filtration"—C. E. Keefer and E. C. Cromwell, *Sewage Works Journal*, November, 1932.

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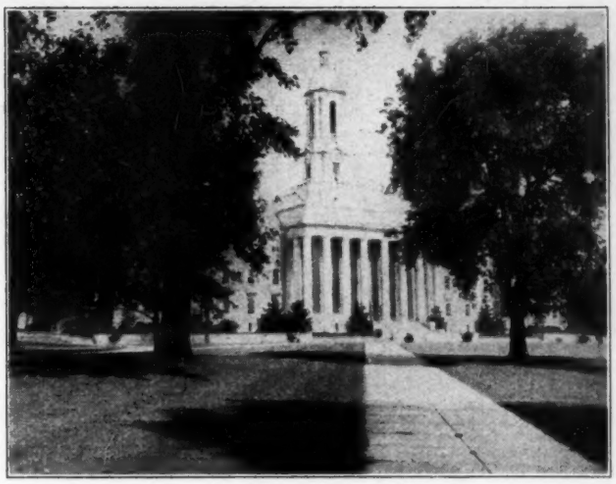
Niagara Falls Plans Filtration Plant and Sewage Treatment Works Under NRA

The city of Niagara Falls has prepared plans for the construction of a new filtration plant which will practically duplicate the capacity of the existing plant. The plans have been examined and approved by the N. Y. State Dept. of Health and application has been made by the city for federal aid under the NRA plan.

The city council also recently approved the construction of sewage treatment works. Of the several cities along the Nigara river, Nigara Falls is the first to authorize treatment of its sewage before its discharge into the river.

MEETING OF PENNSYLVANIA WATER WORKS OPERATORS' ASSOCIATION*



"Old Main" and the Lawn, In Which and On Which, the Sessions Were Held.

THE Sixth Annual Conference of the Pennsylvania Water Works Operators Association, with 166 in attendance, was held at State College, Pa., September 7, 8 and 9, 1933.

The conference was preceded by a golf tournament participated in by members of the Water Works Operators Association and the Sewage Works Association, which had held its conference on the two preceding days and a novelty of the meeting was the comfortable open air session held under the trees on the college lawn.

George R. Taylor, Chemist, Scranton Spring-Brook Water Service Company, and a former President of the Association, lectured on the "Study and Control of Algae" at the opening session on the evening of the seventh. His illustrated talk brought forth considerable discussion and questioning from the floor.

The address of welcome was made by Professor Sackett, Dean of Engineering, State College, Pennsylvania.

Business Meeting

(President E. C. Trax of McKeesport, Pa., presiding.)

Secretary Glace reported a growth of the Association during the year to 285 members.

In view of the fact that there seems a probability that N.R.A. funds to the extent of $350,000 will be available to devote to sealing of mines which damage streams with acid drainage from abandoned workings, the Association passed a resolution urging that funds be allotted for such purposes. The proposal at present is that $100,000 be spent in each of the states of Pennsylvania and West Virginia; an additional $100,000 in all other states and that $50,000 be devoted to a study seeking a permanent and effective remedy for the problem.

The Association voted unanimously for an Operators Short Course to be held yearly at State College.

The Committee on Licensing of Operators, through Chairman J. S. Dunwoody, reported that the matter of licensing water works operators had many angles requiring further study and the existing licensing regulations in other states were not without objections. The Committee asked for more time before making its report.

Officers elected for the ensuing year were:

President—Martin E. Flentje, Chief Chemist, Community Water Service Co., Greensburg, Pa.

Vice-Presidents—H. M. Freeburn, Division Engineer, State Dept. Health, Philadelphia, Pa.; Chas. L. Fox, Engineer, Penna. Water Company, Wilkinsburg, Pa.

Secretary-Treasurer—I. M. Glace, Division Engineer, State Dept. Health, Harrisburg, Pa.

Martin E. Flentje, President of the Association.

E. C. Trax, Retiring President of the Association.

The Smoker

A buffet supper followed by a smoker was presided over by John J. Shank, President of the Wayne Laboratories, Waynesboro, Pa., who acted as master of ceremonies. Golf prizes were awarded as were other prizes and "special" prizes of a fun-making nature. The master of ceremonies, we understand, wasn't at his best because he had his style cramped a bit due to the presence of young lady waitresses.

"The Trouble Hour"

As in the case of the Conference of the Sewage Works Association a highly interesting feature was the holding of a symposium wherein operators recounted difficulties and troubles met with in operation and measures employed to overcome them. A prize* offered by officers of the Association for the most instructive "Trouble Hour" paper was awarded M. V. Priester of Verona, Pa., for his paper on the reconditioning of sand beds in rapid filters. Mr. Priester's paper is to be printed in a forthcoming issue of WATER WORKS AND SEWERAGE but is briefly reported along with other "Trouble Hour" topics.

"Reconditioning Filters"—M. V. PRIESTER, Suburban Water Company, Verona, Pa.

Mr. Priester reported that manganese coating on sand,

*A check to cover a 2 years' subscription to WATER WORKS AND SEWERAGE.

*The meeting of the Pennsylvania Sewage Works Association, held at State College on Sept. 6th and 7th, was reported in our October issue.—*Editor.*

I. M. Glace, Secretary of the Association.

mud-ball formation, cracks in sand beds and odors had been eliminated by draining, application of solution of chlorinated lime (about 50 p.p.m.) allowing to stand 48 hours and then given a low rate of wash along with an auxiliary washing, employing a hose and a long piece of one-inch pipe as the nozzle, to remove the loosened dirt from the stand. Chlorine water had also been used with the same results. Length of filter runs had been increased and they planned to repeat the treatment as required.

"Correcting Coagulation Difficulties" — M. D. BAKER, West Penn. Power, Springdale, Pa.

Mr. Baker said, that in treating the Alleghany River Water, which changed rapidly from alkaline to acid reaction, the floc was easy to lose and difficult to maintain. To relieve this situation aluminate of soda had been employed with good effect. A pH range of 4.9 to 8.0 seemed to be satisfactory when using the aluminate, but for greater speed in flocculation a pH of 5.0 had proven preferable. At pH 5.4 the speed of floc production began to drop off and too heavy dosages of aluminate produced an after-precipitation in the filter effluent. Operating to produce pH 5. to 5.5 had been the solution to their problem.

"Overcoming Taste Troubles"—R. W. HAYWOOD, JR., Superintendent of Filtration, Lehigh Water Company, Easton, Pa.

Mr. Haywood said that tastes in the Delaware River water had been attributed to the presence of decayed organic matter, including decomposing algae. Preammoniation with prechlorination had not remedied conditions. Stopping the ammonia and raising the raw water chlorine dosage to between 2.5 and 3.0 p.p.m. to carry residuals of 0.1 to .05 onto the filters had seemed to do the job. The high chlorination had seemingly oxidized the taste producing substances during travel of the water through the basins and the ammonia application had been changed to the filter effluent along with a secondary (post) chlorine application.

"Saving on Pumping Costs"—T. H. KAIN, Engineer, Columbia Water Company, Columbia, Pa.

Mr. Kain reported that his company had been able to effect a 60 per cent reduction in pumping costs by substituting, for steam pumping, Deisel engine driven pumps and in January, 1933, a self-oiling 100 h.p. Worthington-Deisel engine had been placed in operation. To pump 1.5 m.g.d. the fuel oil consumption had been but 5 gals. per hour at the engine speed of 480 r.p.m. which is boosted to 1,600 r.p.m. to drive the centrifugal pumps.

"Control of Reservoir Aftergrowths"—S. C. BAILEY, Danville, Pa.

To hold a reservoir in steril condition Mr. Bailey said that they had successfully employed "H.T.H." applied to the surface of the reservoir from a boat once each week. Later they had used ammonia also and applied the ammonia-chlorine treatment twice weekly.

GEORGE R. TAYLOR gave an interesting account of the chemist's value in serving and assisting consumers and thereby improving public relations. A large bakery washing tin pans in vats had losses due to pan corrosion for which the water supply was being held to account. Investigation showed that the water in the washers, made quite alkaline in the morning, dropped in pH value with increased usage. Adding more of the washing powder at intervals, to maintain a pH value of 8.4 or higher, had eliminated the corrosion losses almost completely.

"Correcting Corrosion of Pipes"—A. O. NEWQUIST, Greensburg, Pa.

Mr. Newquist reported that consumers complaints had been noticeably reduced by raising the pH of the filter effluent to 8.0 with lime. The tap water with alkalinity of but 11 p.p.m. and pH 7.4 continued to show an iron content of 0.2 to 0.7 p.p.m. but nevertheless "red water" complaints had been far fewer than formerly.

"Abnormal pH of Raw Water"—R. C. GORMAN, State Department of Health, Harrisburg, Pa.

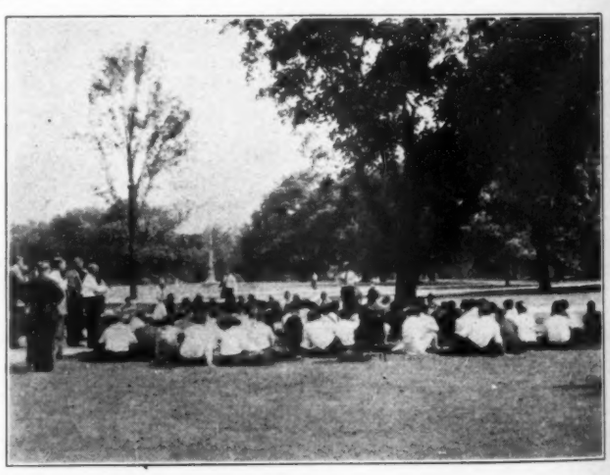
Mr. Gorman had run onto a somewhat baffling matter of sudden rise of pH value of a raw water (impounded) which was preceded by sudden algae increase. The normal pH value of 7.2 had reached pH 10, floc formation had been interfered with and short filter runs observed. The total alkalinity, by titration, had not increased with the pH jump and the algae had apparently been responsible for this condition.

Others to contribute to the "Trouble Hour" symposium were R. B. Adams of Wilkinsburg; James Fergus of West Newton; P. M. Hess of Safe Harbor; C. R. Keatley of Lancaster; G. L. Kelso of Apollo and J. P. Snow of New Kensington.

In discussing Mr. Adams' report of reservoir pollution by birds, J. M. Caird of Troy, N. Y., said that gulls on the West Coast had been very troublesome until the scheme of stretching copper wires (crossing to form 20 ft. squares) above the reservoir had been effective in keeping the gulls away. Something of the sort to keep birds and pigeons away might be worthy of a trial.

Technical Papers

"Coagulation Control"—MARSDEN C. SMITH, Engineer in Charge of Water Purification, Richmond, Va.



M. E. Flentje Speaking Before the Open-Air Sessions Held Under the Trees on the College Lawn.

Mr. Smith referred to the experiences at the Richmond, Va. Filtration Plant which once again proved the high importance of properly conditioning water for efficient coagulation, settling and filtration—the last named operations giving little concern when the first had been properly done. To give the raw water the most nearly perfect conditioning and flocculation possible had been their highest aim at Richmond. Time and effort had yielded results which led up to the design and installa-

tion of paddle "flocculators" within the coagulation basins—the location being at the immediate inlet ends. The slow motion flocculation followed the short period rapid mixing of chemicals and water and served to build up a rapid settling floc. The principle involved was that of returned floc to serve as nuclei and absorbing material plus that of giving the inflowing water a rolling motion. In addition the flocculators served to smooth out any fluctuations in chemical treatment. The flocculators had cut coagulation costs just about half. (For a description of the Richmond flocculators see Mr. Smith's article in WATER WORKS AND SEWERAGE for June, 1932.—*Editor.*)

Mr. Smith was strongly of the opinion that laboratory coagulation tests should be routine practice and they at Richmond had found it possible to save considerably on chemicals and wash water by such practice. A refined laboratory stirring machine with exact speed control had been developed for these tests which were applied daily or as frequently as necessary to insure maximum coagulation efficiency with a minimum of coagulant. Conditioning the raw water sometimes with but slight lime addition and at other times with acid had proven effective measures as disclosed by the laboratory coagu-

Groups on the Campus Between Sessions. Left: Jordan, Carpenter, Laborn, Kuhns, and Rear View of Freeburn. Right: Sykes, Forte and Rear View of "What's His Name."

lating tests on 500 c.c. raw water samples. These tests required but 15 minutes to perform.

Prechlorination had been highly valuable and was continuously practiced to maintain residual chlorine out in the coagulation basins. This had required not less than 10 lbs. of chlorine per million gallons and upward to 25 lbs. per m.g. to procure the effects desired.

To insure production of taste free water, powdered carbon was being used more or less constantly. For a time the carbon had been applied continuously at about 10 lbs./m.g. to the filter influent. More recently about one-third that amount had been required as the result of a system developed by which carbon is applied to each filter for a short time immediately following the wash and then discontinued. The carbon required had been weighed out and emptied into a dry feed machine which feeds out the "batch" to the individual filter influent line during a period of a half hour or less to serve during the length of runs between washings.

Ammonia applied to the filter effluent followed by post chlorination insured a taste free water which carried residual chlorine unnoticed to the far reaches of the distribution mains. Lime was being added as the final touch to maintain a pH value of 8.4 as a corrosion prevention measure. Mr. Smith explained that they really depended upon the prechlorination to produce high safety and the ammonia-chlorine treatment as a means of keeping the water safe and free from taste out in the mains and reservoirs.

Mr. Smith suggested the following for consideration by fellow operators:

Sterilize early; employ laboratory control in flocculation; use a mechanical preparation device in addition to rapid mixing; employ adequate taste control processes; and depend upon the State and City Health Departments for assistance, advice and protection.

"The Service of the Laboratory to the Water Purification Plant"—HARRY E. JORDAN, Indianapolis Water Company, Indianapolis, Ind.

Mr. Jordan, in citing the importance of laboratory control in water purification, said that 50 per cent of the typhoid outbreaks in recent years had been traced to failures in purification processes. In one instance such failure had resulted in 2,500 cases of dysentery in a large city. There was ample evidence to indicate that there are limitations of pollution loadings which modern purification processes could cope with safely. There would always be emergencies and the operators of purification plants should be trained to cope with such.

The chemist must look beyond the routine. He must step out of the laboratory and run the plant. He must look constantly for new questions to answer in an effort to improve conditions. He should perform administrative control and insist on cleanliness and order around the plant. Adequate preparation of the coagulated water being responsible for 60 to 83 per cent of the plant performance, attention to that feature and proper sterilization control, were by far the most important items in purification practice. Filter performance was also important and effluents were now watched for the first signs of turbidity. Filters should produce effluents of less than 0.2 p.p.m. turbidity if the water has been adequately prepared and the filters kept in proper condition.

The control of chlorination, said Mr. Jordan, had long since gotten out of the laboratory and 24 hour control of chlorination necessitated operator dependence—and a personnel capable of making residual chlorine tests at all hours. The chemist must train his men properly and depend on them for results no less efficient at 3:00 a. m. than those at 3:00 p. m. He referred to the availability of activated carbon for taste control as being a very comforting development. The ammonia chlorine treatment deserved more attention, but it must be realized that when employed higher residuals were required for safety and that reliance on short period sterilization was unsafe. The idea of saving chlorine by use of ammonia was ill conceived and a dangerous practice.

In taste and odor determinations and taste and odor control, the threshold test of Spalding (see Journal A.W.W.A. Aug. 1932 and WATER WORKS AND SEWERAGE, December, 1932) should be more generally used. For determination of phenol the Fox and Gage procedure had, with slight modification, been successfully used at Indianapolis and was more practical than other available methods. The use of Brilliant Green Bile in the bacteriological laboratory had doubled the number of samples examined per day per man. He considered the bacteriological findings, however, as but a certificate of performance—the residual chlorine test being the indicator to determine promptly that performance is safe. Mr. Jordan exhibited lantern slides showing turbidimeters and residual chlorine test sets which the Indianapolis operators had been trained to use at all hours.

GEORGE NORCOM, Federal Water Service Company, New York, said that he was impressed with Mr. Jordan's statements and was of the opinion from observation that small plants should all have some degree of supervision by men of training and experience.

PROFESSOR L. V. CARPENTER, University of West Virginia, Morgantown, W. Va., made a very pertinent remark when he said that there were at least three things every plant operator, large or small, could do—keep the

plant clean and neat, be neat himself and make residual chlorine tests as frequently as necessary.

"Filter Plant Operating Experiences"—L. E. WICKERSHAM, Engineer, American Water and Electric Company, New York City.

Mr. Wickersham said that in his experience he had found that the keeping of operating data could be overdone to the neglect of operation which suffered from too much laboratory and paper work. He outlined suggested operating items for consideration by the operator and said that prechlorination with use of activated carbon seemed to be the one best taste and odor control process. He recommended the employment of the distillation test on chlorinated raw water samples, as routine, to determine when tastes and odors were to be expected and, therefore, dealt with. He said the application of hypochlorites to filter beds had been very helpful in keeping the sand bed in shape. Two treatments were usually required, allowing 12 hour contact after the high chlorine application. He did not believe that mud-balls were always due to faulty coagulation but frequently to the organic content of the water which could be removed with difficulty only.

CHARLES J. BRUCE, Superintendent, Evitts Creek Water Co., Cumberland, Md., said that the Cumberland filters were filled with ground anthracite coal which had been giving satisfaction for 20 years. Caustic soda (1 per cent solution) with 48 hour contact followed by air agitation for 24 hours had been effective in removing organic accumulations.

F. E. STUART, Industrial Chemical Sales Company, reported on the super-chlorination process of sand cleaning, developed by Mr. Wier, Supterintendent of Filtration at Atlanta, Ga., which had proved superior to caustic soda.

GEO. NORCOM said that the nature of coatings would determine whether acid or alkali was the best cleansing agent. Laboratory test would reveal the most efficient treatment.

"Construction and Protection of Drilled Wells"—A. G. FIEDLER, Hydraulic Engineer, U. S. Geological Survey, Washington, D. C.

Mr. Fiedler discussed the methods of well drilling now commonly employed, and described in some detail the tool-percussion and the hydraulic-rotary methods. He reviewed the most probable sources of well pollution to be considered in making wells safe. The real danger zone, he said, occurred in the upper limits of the ground water elevation and therefore it was highly essential that casings extend well below the expected minimum water table elevation. Water from wells in creviced rock formation (limestone in particular) should be chlorinated continuously if safe practice was to be assured. Furthermore, only the very best materials should be used for casing—employing nothing less resistant to corrosion than wrought steel. Methods of sealing the casing at its lower end were given in some detail. The strainers of modern times were being made of highly resistant materials with openings designed to let sand in rather than hold it out of the well. The result sought after was a graded gravel intake zone around the strainer which in many instances was now being produced promptly by putting down gravel to create artificially the gravel-wall desired. In such construction the hydraulic rotary method of drilling is employed and the casing is put down after completing the hole.

In all cases chlorination of the finished well should be considered. Hypochlorite solutions were commonly applied by use of the dump boiler and pressure applied at the well top after lowering the hypochlorite had produced superior results. Mr. Fiedler stressed the fact that modern well drilling was a highly technical business requiring knowledge, experience, skill and precautions—intimating that selection of a well driller should be based on something more than competitive bidding.

In reply to a question, Mr. Fiedler said that screen slots were generally arranged to allow 30 to 50 per cent of the sand surrounding the screen to be drawn through into the well. Developing wells in sand strata was a highly important part of the well project and required considerable knowledge and skill.

H. M. FREEBURN reported that a long drop hose feeding chlorine into wells continuously or intermittently had been found unsatisfactory and that now high pressure force pumps were being used to operate chlorinators against the pressure on the well pump discharge line.

HARRY KRUMM told of a scheme evolved by him to automatically start and stop chlorine feed by use of an electromagnet which was energized when the pump motor at the automatic station started and stopped.

"Old Main," State College, Pa., as It Looks at Night.

The Effect of Road Tars on Water Supplies

MARTIN E. FLENTJE of the Community Water Service Company, introduced the subject of the ill effects of road oils and tars on water supplies by recounting instances wherein run off from freshly treated roads had created trouble from chlor-phenol tastes in water supplies. He felt that some further consideration should be given to correcting this troublesome matter.

H. M. FREEBURN cited five cases of the above nature in which foul tastes had been created. Studies had indicated that tars varied in taste production powers and cited phenol concentrations found in run off from tarred sections at the end of various intervals following application. In one case the dilution of run-off water 1 to 50 million had imparted taste to the chlorinated water. In others the ratio was 1 to 500,000. Experience seemed to point to the fact that 24 hours after application the run off from rains would produce little or no trouble.

L. V. CARPENTER of Morgantown, W. Va., reported that, in coöperation with the West Virginia Highway Department, some preliminary investigations had already revealed that the road primer coat will produce tastes if rained on shortly after application but had not done so a day or two later. The final coat, 1 hour after application, had produced some taste. This had been the beginning of more elaborate and exact studies of the effects of road tars of various kinds, in which the taste producing test consisted of chlorinating dilutions of run-off water and boiling away the slight excess chlorine before tasting.

C. L. SIEBERT, of the Sanitary Water Board of Pennsylvania, reported cases of fish kill due to washings from

freshly tarred roads. It seemed that the coal tar base preparations had been the greatest offenders.

Anthracite Coal in Filtration

"Anthracite Coal as a Filter Medium"—H. G. TURNER, Director, Anthracite Institute, State College, Pa.

Mr. Turner presented, in a paper by himself and G. S. Scott, the results from a series of tests applied to ground anthracite coal employed as a filter medium. The paper was in effect a summary of the several investigations reported during the past year in a series of articles which have appeared in WATER WORKS AND SEWERAGE and to which some more recent information had been added. The high resistance of anthracite to acid and hot alkali attack, its freedom from slime accumulations, its light gravity and uniformity of particle size dispersion through the bed, its clean shiny surfaces and relative freedom from incrusting difficulties when used in softening practice, long filter runs and greater void area, lack of shrinkage and its resiliency—all at a reasonable cost, made anthracite appear to be an ideal filtering material. Its low gravity (one half the weight of sand per unit volume) and its ready lifting meant that less wash water velocity was required to float the bed and cleanse it. In addition, anthracite had some power apparently to absorb coagulant and residual chlorine and even coloring matter. He believed therefore that anthracite used at Harrisburg, Pa., Denver, Colo., Steelton, Pa., Dallas, Tex., Cumberland, Md., and more recently at Columbus, O.,* for water filtration had merits which should interest water works operators and engineers.

E. C. TRAX, President of the Association, said that he was very much interested in the non-incrusting quality of this material as that was quite a problem with filter sand.

C. J. BRUCE, Manager, Evitts Creek Water Co., Cumberland, Md., reported 20 years of experience with anthracite filters at Cumberland. This plant, like the several others employing anthracite, had been designed by the late J. H. Fuertes. At Cumberland the water had high turbidity and the coagulating basin was very small—(30 minute detention) which resulted in heavy loadings on the filters proper. He wondered what shape sand filters would have gotten into under similar conditions. The beds were being washed first with air followed by low velocity wash rate of 14 inches rise per minute, but it had never been necessary to remove the coal for cleaning in all these years.

L. H. ENSLOW spoke of his interest in anthracite ever since observing the condition and free washing of the Dallas (Tex.) filters. The fact that anthracite beds seemed to do work for their entire depth was in line with the most modern ideas leading to recent specification of coarse grained filters. The low gravity seemed to offer advantages in that the bed could be properly floated during washing at much reduced rates and consequent economy in design of wash water appurtenances and probably less wash water on the average. The day of the "schmutzdecke" on filters had been relegated to the collection of antiques and any material, washing freely and clean, that possessed the wearing quality apparent in anthracite should arouse the interest of all water works and sewerage men to the extent that it be given a thorough trial for comparison and evaluation as an economical and scientific medium.

In reply to questions, Mr. Turner said that "anthrafilt" was the trade name of the anthracite filter material which weighed 55 lbs. per cu. ft. as against sand at 100 lbs. per cu. ft. The cost of filling a filter would therefore be about the same as for sand. They estimated a washing loss of 0.5 per cent of "anthrafilt" per year. The material could be obtained through the Anthracite Institute, which was attempting to see that the proper specifications would be met in its production.

President E. C. Trax turned over the gavel to the President-Elect M. E. Flentje, who after a brief speech of acceptance, adjourned the meeting until 1934.

*Note: Elsewhere in this issue appears an article by C. P. Hoover which recounts 13 months operating results from an anthracite filter at the Columbus plant.—*Editor.*

NRA Releases of Information Covering Loans and Grants to Cities for Water Works and Sewerage Projects

RELEASE NO. 1

State and City	Project	Allotment
Florida, Pahokee	Water works	$ 100,000
Missouri, Clarkton	Water works	20,000
Montana, Fort Benton	Water works	45,000
South Dakota, Spearfish	Water works improvements	41,000
Wyoming, Newcastle	Water works	20,000
D. of C., Washington	Sewerage	1,759,500

RELEASE NO. 2

State and City	Project	Allotment
Wisconsin, Eau Claire	Water works improvement	$ 250,000
Wisconsin, Madison	Sewerage	913,000
Wisconsin, Madison	Section of storm and sanitary sewers	135,000
Wisconsin, County of Milwaukee, Board of Supervisors	Sewerage	1,850,000

RELEASE NO. 3

Location	Project	Loan and Grant*	Amount*
Sacramento, Calif	Water works	L. and G.	$ 11,700,000
Norfolk, Conn.	Water works	Grant	75,000
Fargo, N. D.	Sewerage	L. and G.	512,000
Fort Atkinson, Wis.	Sewerage	Grant	18,315
Vill. of Minnesota Lake (Minn.)	Water works	Grant	2,730
Bel Aire, Md.	Sewerage	L. and G.	124,750
Clear Spring, Md.	Water works	L. and G.	23,000
Vienna, Md.	Water works and sewerage	L. and G.	27,000
Springfield, Ill.	Water works	L. and G.	1,385,000
Cincinnati, O.	Sewerage	Grant	8,850
Cincinnati, O.	Storm sewer	Grant	160,000
Cincinnati, O.	Sewerage	Grant	8,730
Huntington, Ind.	Water	Grant	84,750
Merrill Water Co., Oregon	Water works	Loan	17,000
Cocome, S. D.	Water works	L. and G.	25,500
Green Bay, Wis.	Sewer	L. and G.	722,907
Oshkosh, Wis.	Sewer	L and G.	968,000
Marlboro, Mass.	Sewer	L. and G.	25,000
Springfield, O.	Sewer	L. and G.	904,364
Detroit, Mich.	Sewer	Grant	21,000
Omaha, Neb.	Water works	Grant	290,256
North Kingston, R. I.	Water	L. and G.	110,000
Morrison, Colo	Repairing water works system		20,000

*Wherever the amounts listed are for "Grants" only the figures shown are approximately one-fourth the amount to be spent on the project.

Location	Project	Amount
Montgomery, Ala.	Installation of deep well pumps in five existing wells	$ 70,000
East Brunswick, N. J.	Laying cast iron mains and installation of valves, hydrants and other appurtenances	60,000
Petersburg, Ind.	Construction of water filtration works and an electrically operated pumping station	50,000
Northport, Mich.	Construction of a deep well, pumping station and distributing system	32,000
Uniontown, Ala.	Construction of a reservoir and installation of a new pump	6,000
Warrentown, Ga.	Construction of a deep well	6,000

RELEASE NO. 4

Location	Project	Loan or Grant	Amount
Salem, Ore.	Water system	L. and G.	$ 1,500,000
Waupaca, Wis.	Sewer system	L. and G.	65,000
Valley City, N. D.	Sewerage plant	L. and G.	77,000
Fremont, O.	Relief sewers	L. and G.	325,000
Hampton, N. H.	Sewerage system	L. and G.	160,000

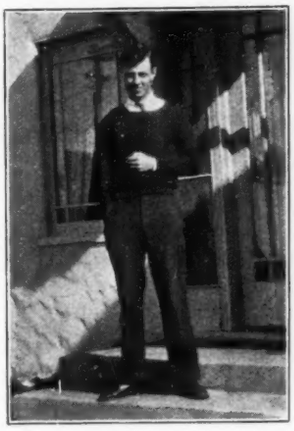
Location	Project	Loan or Grant	Amount
Evanston, Ill.	Water works	L. and G.	250,000
Rosiclare, Ill.	Water works	L. and G.	115,000
St. Louis, Mo.	Relief sewers	Grant	104,000
Manchester, N. H.	Reservoir	L. and G.	250,000
Des Moines, Ia.	Sewer	Grant	80,000
Des Moines, Ia.	Sanitary sewers	Grant	4,300
Dubuque, Ia.	Storm sewers	Grant	8,000
Cleveland, O.	Sewage works	L. and G.	8,990,000
Shenandoah, Ia.	Water works	Grant	38,000
Lewiston, Ida.	Water mains	Grant	5,000
Albert Lea, Minn.	Water mains	Grant	6,000
Louisville, Ky.	Sewage system	Grant	290,000
	RELEASE No. 5		
Crete, Neb.	Sewer	Grant	$ 8,100
Kennett, Mo.	Sewerage	L. and G.	408,000
Ames, Ia.	Storm sewer	Grant	9,000
Ames, Ia.	Sewerage	Grant	6,000
Cedar Rapids, Ia.	Sewerage	L. and G.	683,160
Toledo, Ia.	Sewerage	Grant	2,500
Newton, Ia.	Sewerage	Grant	10,000
Emmetsburg, Ia.	Water works	Grant	6,500
Pocahontas, Ia.	Storm sewer	Grant	900
Stoughton, Wis.	Water works	L. and G.	16,000
Cleveland, O.	Water mains	Grant	800,000
Cleveland, O.	Sewerage	Grant	135,000
Oklahoma City, Okla.	Water mains	Grant	1,500
Massillon, O.	Intercepting sewer	L. and G.	160,000
Tama, Ia.	Storm sewer	Grant	6,000
McPherson, Kan.	Elevated water tank	Grant	3,500
Oklahoma City, Okla.	Sewer	Grant	16,500
	RELEASE No. 6		
Annapolis, Md.	Sewer system	L. and G.	$ 490,000
Richford, Vt.	Dam and water supply	L. and G.	80,000
Osceola, Ia.	Water works	Grant	15,810
Marion, Ia.	Sewer system	L. and G.	20,000
Norton, Kan.	Sewer system	L. and G.	38,500
Bernardsville, N. J.	Sewer extensions	L. and G.	80,000
Hillsboro, Wis.	Water works	Grant	1,500
Honolulu, T. H.	Water works	Grant	160,000
Newburyport, Mass.	Water works	Grant	20,000
Thief River Falls, Minn.	Power plant and waterworks	Grant	15,000
Dallas, Tex.	Storm sewers	Grant	195,000
Monaca, Pa.	Sewer and water systems	Grant	13,000
Providence, R. I.	Water works	Grant	171,000
Havelock, Iowa	Water tank	Grant	1,200
Baltimore, Md.	Sewer system	Grant	60,000
Baltimore, Md.	Pumping station (water)	Grant	39,000
Mechanicsville, Ia.	Water tank	Grant	1,500
Ringsted, Ia.	Water tank	Grant	1,400
Algona, Ia.	Water tank	Grant	5,100
Elgin, Ill.	State Hospital—Sewer system	Grant	22,500
Montpelier, Vt.	Water supply	Grant	1,123
Springfield, Mass.	Sewers	Grant	110,000
Macon, Ill.	Water supply system	L. and G.	34,000
	RELEASE No. 7		
Shippensburg, Pa.	Water line	L. and G.	$ 150,000
Chicago, Ill.	Sewerage	L. and G.	8,000,000
Beaver Dam, Wis.	Sewage plant	L. and G.	210,000
San Antonio, Tex.	Sewers	L. and G.	1,430,000
Westminster, Md.	Sewage system	L. and G.	289,000
Arlington County, Va.	Sewerage system	L. and G.	2,500,000
Marshall, Minn.	Sewerage repairs	Grant	9,000
Waconia, Minn.	Sewage plant	Grant	6,000
Harbor Springs, Mich.	Sewers	Grant	4,200
Burlington, Wis.	Reservoir	Grant	1,000
Georgetown, S. C.	Water system	L. and G.	10,000
Monte Vista, Colo.	Reservoir	Loan	2,600,000
Dillon, Mont.	Reservoir	Loan	75,000
Columbus, O.	Sewage plant	L. and G.	3,400,000
Columbus, O.	Sewers	L. and G.	1,800,000
Palo Alto, Cal.	Sewer	Grant	29,000
Peoria, Ill.	Sewer	Grant	23,000
Baltimore, Md.	Sewer	Grant	9,000
Colorado Springs, Colo.	Water lines and dams	Grant	285,000
Cloverdale, Calif.	Sewer	Grant	1,700
Wilmington, Del.	Water works	Grant	72,000
San Francisco, Cal.	Dam	Grant	798,000
San Francisco, Cal.	Water system	Grant	2,695,000
San Francisco, Cal.	Sewer	Grant	545,000
	RELEASE No. 8		
Cincinnati, O.	Water mains	L. and G.	$ 792,000
Shelby, O.	Sewage treatment	L. and G.	50,000
Springfield, Mo.	Sewers	L. and G.	1,000,000
Bethany, Mo.	Sewers	L. and G.	133,000
Warwick, R. I.	Water works	L. and G.	60,000
Durham, N. C.	Sewers	L. and G.	710,000
Geneva, Ill.	Sewer	Grant	4,000
Springfield, Minn.	Water purification	Grant	2,500
Lakin, Kan.	Water works	Grant	1,000
Lawrence, Kan.	Water tank and tower	Grant	2,100
Dustin, Okla.	Dam	Grant	5,000
Fort Atkinson, Wis.	Water supply	Grant	9,500
Oakley, Kan.	Water works	Grant	2,500
Bloomfield, Ia.	Water works	Grant	3,200
Falls City, Neb.	Water mains	Grant	5,400
Everett, Wash.	Water works	Grant	38,000
Middlebury, Vt.	Sewer	Grant	2,000
Cincinnati, O.	Sewer	Grant	6,500
Cincinnati, O.	Sewer	Grant	1,200
Cincinnati, O.	Sewer	Grant	2,400
Dyersville, Ia.	Sewer	Grant	700
Butler, Mo.	Sewage disposal plant	L. and G.	41,000
Belington, W. Va.	Filtration plant	L. and G.	45,000
Pocatello, Ida.	Water mains	L. and G.	149,674
Pocatello, Ida.	Reservoir	L. and G.	187,000
Ann Arbor, Mich.	Sewerage	L. and G.	650,000
Fond du Lac, Wis.	Sewage plant	L. and G.	434,700
Harrington, Del.	Sewer	L. and G.	125,000
Carlisle, Pa.	Sewage	L. and G.	220,000
East Grant Forks, Minn.	Water works	Grant	5,000
Lincoln, Neb.	Water works	L. and G.	216,000
Aberdeen, S. D.	Water works	L. and G.	789,000
Anderson, Ind.	Water works	L. and G.	209,000
Monson, Mass.	Sewer	L. and G.	65,000
Rutland, Vt.	Sewer	Grant	31,000
Rochester, Minn.	Sewer	Grant	24,000
Austin, Minn.	Water supply	Grant	3,000
Franklin, Pa.	Water works	Grant	1,500
Mason City, Ia.	Water works	Grant	5,700
Glendale, Cal.	Reservoir roof	Grant	27,000
	RELEASE No. 9		
Brainard, Neb.	Sewage system	L. and G.	$ 22,000
Cotter, Ark.	Waterworks system	L. and G.	55,000
Georgetown, Ill.	New waterworks system	L. and G.	140,000
Manchester, N. H.	Reservoir	Grant	61,000
Albion, Ind.	Turbo-generator, spray pond and water tank	L. and G.	32,000
Sanitary Commission, Anne Arundel County, Md.	Sewage disposal connections	L. and G.	62,000
Bristol, R. I.	Sewage stations and treatment plant	L. and G.	200,000
Grand Junction, Colo.	Water settling and storage basin	L. and G.	100,000
Spearfish, S. Dak.	Intake dam and piping	L. and G.	64,280
Board of Public Utilities, Kansas City, Kan.	Waterworks, storage tanks, pumping equipment and mains	Grant	29,000
Belgium, Wis.	Sewage system extension	Grant	2,000
Montpelier, Vt.	Sewer enlargement	Grant	900
Kasson, Minn	Well for water supply system	Grant	300
Board of Water, Electric, Gas & Power Commission, Austin, Minn	Warehouse and garage	Grant	9,000
Ogden City Corp., Weber Co., Utah	Waterworks	L. and G.	750,000
Vineland, N. J.	Well for water supply	L. and G.	35,000
Hartsville, S. C.	Waterworks improvement and extension	L. and G.	73,000
McPherson, Kan.	Water system extension	Grant	12,000
Paxton, Mass.	Water supply	L. and G.	85,000
Rapid City, S. Dak.	Sewage treatment plant and trunk sewer	L. and G.	180,000
Williamsport, Md.	Sewers and sewage plant	L. and G.	88,000
Denver, Colo.	Waterworks	L. and G.	3,500,000
East Cleveland, O.	Culvert storm sewer	Grant	7,200
Hutchinson, Minn	Sewage plant	Grant	18,000
Moscow, Ida.	Water mains and chlorine equipment	Grant	4,000
Merrimack, N. H.	Water system	Grant	6,000
Delhi, Ia.	Water tank and distribution system	Grant	4,500
Brookline, Mass.	Water drains	Grant	3,600
Wapello Co. Tuberculosis Hospital, Ottumwa, Ia.	Sewage disposal plant	Grant	2,000
West Union, Ia.	Water tank and mains	Grant	3,300
Hudson, Ia.	Water mains	Grant	500
Laurens, Ia.	Sewage disposal plant	Grant	2,100
Harrisburg, Pa.	Storm and sanitary sewers	Grant	7,000

THE PRACTICE OF WASTING EXCESS ACTIVATED SLUDGE

Observations of the Effects of Its Return to the Crude Sewage for Separation in Primary Clarifiers

By T. R. HASELTINE

Superintendent, Sewage Treatment, Salinas, Calif.



The Author

WHEN the practice of digesting excess activated sludge along with primary sludge in separate digestion tanks was first used the activated sludge was pumped directly to the digestion tanks. This practice produced a very thin, liquid, sludge in the digesters, increased heat requirements and, in many cases, resulted in an overflow liquor of high solid content and foaming due to inadequate digestion space for the high moisture sludge. Practically every plant has felt the need of concentrating the fresh solids before pumping them to the digestion tanks and at some it has been essential to reduce the moisture content in order to obtain anywhere near satisfactory functioning of digestion processes.

To overcome these difficulties it has become common practice to waste the excess activated sludge by delivering it, at a slow rate, to the crude sewage in order that the mixture of crude and activated sludge solids may settle out in preliminary sedimentation tanks. Fischer[1] was the first to report on this method of concentration and he, Goudey[2], Haseltine[3] and others have reported on the improved functioning of digestion tanks resulting from this practice. The writer, however, knows of no detailed published data on the effects of this practice on sedimentation and aeration processes and in order to set forth some of our observations at Salinas this article is being prepared.

Review of Literature

Fischer[1] found "that it was necessary to waste the activated sludge continuously at a slow rate to the primary clarifiers to secure maximum concentration of the combined raw and activated sludge in the clarifiers, and to pump the concentrated sludge to the digester for short periods at frequent intervals. If possible, the mixed sludges should be pumped (to digesters) continuously at a low rate." He found it necessary to carry a 2-foot sludge blanket in the primary clarifiers (which had an 8-foot side water depth) in order to concentrate the sludge but gives no information as to what, if any, effect this had on the clarifier effluent. He states that, if the rate of wasting the activated sludge is too high the sludge will not concentrate and some floc will flow over the effluent weirs to the aeration units.

Goudey[2] shows the enormous reduction in the volume of sludge that must be pumped to the digester as a result of this practice but makes no mention of the effect, if any, on sedimentation results.

Haseltine[3] states "that to secure the maximum density of sludge the rate of wasting (activated sludge) must be less than that necessary to prevent floc passing through the settler; * * * it should be the lowest possible rate consistent with the disposal of the required amount of activated sludge. The addition of the excess activated sludge to the primary settler at Salinas has resulted in a higher percentage of suspended matter removed by sedimentation and decreased scum formation on the tank surface."

Albertson[4] in describing the New Canaan, Conn., plant states that "it was found that the addition of activated sludge to the primary tank increased the per cent reduction of suspended solids and B. O. D."

Lacey[5] gives a little information on the early results obtained at Collingswood, New Jersey. During August to October, 1930, inclusive, no activated sludge entered the primary clarifier; the monthly average suspended solids figures were 198 to 275 p.p.b. in the influent and 68 to 75 p.p.m. in the settled effluent. The weighted average per cent removal ranged from 59 to 67. "During November and December activated sludge was constantly returned to the influent end of the primary clarifier, the amount not being known." During November the influent averaged 255 p.p.m. suspended solids, 41 per cent of which were removed; during December it averaged 262 p.p.m. suspended solids, 8:5 per cent of which were removed. There were "several rather irritating occurrences (during December) that affected operation considerably." The addition of the activated sludge did not materially affect the pH of the raw or settled sewage. No comparative data on settleable solids or B. O. D. were given.

Donaldson[6] states that "the delivery of excess activated sludge to inlets of primary tanks promotes greater preliminary clarification and increases the solid content of the sludge." He refers, of course, to the concentration of the activated sludge during separation with the crude solids and not an increased solids content of the crude sludge.

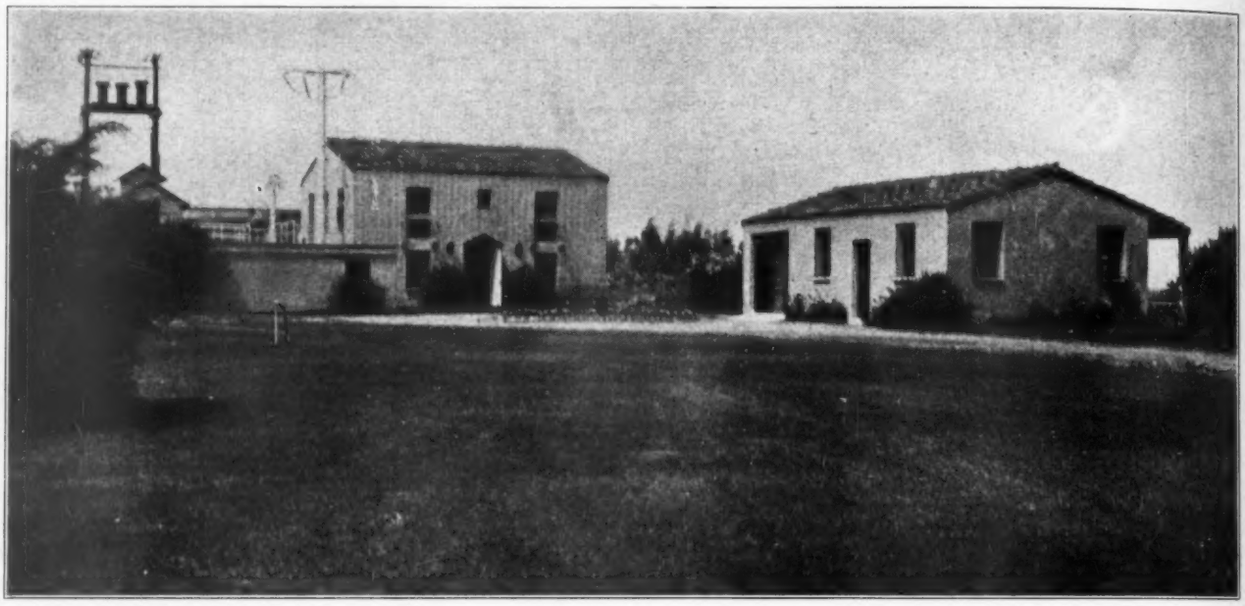
Lumb[9] states that "when activated sludge in good condition is pumped back to the crude sewage and allowed to settle out with the incoming solids, in accordance with practice frequently adopted for its preliminary disposal, a very considerable purification is effected, the action of the activated sludge being similar to that of a precipitant."

Salinas' Experiences

General—The practice of wasting excess activated sludge to the primary clarifiers has been followed at Salinas, Calif., for two years. The low rates of wasting necessary gave considerable trouble with clogging of the throttling valves, etc., and in consequence it was found impractical to waste when no attendant was on duty. During the first year an operator was in attendance 17 hours, but during the second year this time was reduced to 9 hours. The increase in rate of wasting as a result

of this decrease in time of attendance probably increased some of the difficulties mentioned herein, but it is not believed to be the primary cause of any of them.

The Salinas plant has been described in detail (3) & (7) elsewhere. It will suffice to state here that the primary clarifier has a 7-foot side water depth and is equipped with a Dorr traction type mechanism which is operated continuously. The theoretical detention period is 1.4 hours and the settling rate is 900 gallons per square foot of surface area per day, based on present average daily flows. Sludge is drawn by gravity to a sump from which it is pumped to the digester. It has been found necessary to carry a sludge depth of 1 to 3 feet (i.e. 14 to 43 per cent of the tank depth) in order to secure concentration of the sludge which is anywhere nearly adequate. At times when the activated sludge is "bulked" very little sludge concentration occurs and the depth of the sludge blanket builds up to 5 or 6 feet (i.e. 71 to 86 per cent of the tank depth) in spite of continuous withdrawal of the sludge during the operating period. At such times only a very limited amount of fairly heavy sludge can be drawn early in the morning; as the day progresses the sludge becomes increasingly thin and watery.



The Sewage Treatment Plant of Salinas, Calif. Left to Right: Aeration Tanks, Blower House and Laboratory, Pump House. Final Clarifier House and Digester Are in the Rear

Effect on Sedimentation Efficiencies—Table I contains representative average analyses that show the effect of the excess activated sludge upon the efficiency of the sedimentation process. It should be explained that the figures in this table have been selected to represent general averages during periods when approximately the same amount of dry activated sludge solids were pumped to the clarifier. The more solids that are so wasted or the faster they are wasted the more pronounced will be some of the effects noted herein. These data reveal the following facts:

1. That, wasting the activated sludge by return to the crude sewage increases the suspended, settleable and oxygen demand [B. O. D.] content of the clarifier influent. Of these three only the amount of settleable solids by volume is materially affected by changes in the condition of the activated sludge.

2. That, wasting in that manner results in higher *percentage* removals of suspended solids and oxygen demand under most conditions. The poorer the condition of the activated sludge the lower are the removals and the condition of the sludge affects the removal of suspended matter more than it does the removal of oxygen demand.

3. That, in spite of the higher percentage removals of suspended solids and oxygen demand the residue of each in the settler effluent is increased when activated sludge is entering the tank. The increase in B. O. D. values of the effluent ranges from 30 to 50 per cent and suspended matter content rises from 10 to 110 per cent depending upon the condition of the activated sludge.

4. That, regardless of the condition of the activated sludge, the settleable solids content of the primary tank effluent is increased and the actual removal of otherwise settleable solids is decreased. Furthermore, this condition becomes more pronounced with increasingly poor condition of the activated sludge.

Since the final clarifiers at Salinas have a theoretical detention period of 2.8 hours and a settling rate of 800 gallons per square foot of surface per day, as compared with corresponding figures of 1.4 and 900 for the primary settler, it is reasonable to believe that there is considerable matter that might settle out in the final tanks whereas it is too light to settle in the primary tanks. Thus a classification of the activated sludge solids introduced into the primary settler occurs. Only the heavier solids are actually wasted while the lighter ones are returned to the aerators in a presumably very inferior condition due to their long retention in an environment devoid of dissolved oxygen. It is a reasonable deduction that such solids produce a heavy and serious loading on the aeration process at the inlet end of the activation units.

TABLE I—Typical Performances of the Salinas Primary Clarifier

Type of Excess Activated Sludge Wasted to Influent	Influent Analyses			Effluent Analyses*			Per Cent Removals*		
	Susp. Solids p.p.m.	5-day B.O.D. p.p.m.	Set. Solids cc/ liter	Susp. Solids p.p.m.	5-day B.O.D. p.p.m.	Set. Solids cc/ liter	Susp. Solids by wgt.	5-day B.O.D.	Set. Solids
None	399	453	12	153	296	0.4	60.9	34.7	96.5
"Good"	616	698	42	170	389	4.5	72.5	44.3	89 2
"Fair"	579	653	40	270	390	8 5	62.5	40.3	78.7
"Bulked"	651	724	55	323	449	18.0	50.3	38.0	67.0

*In examining the above percentage removals sight should not be lost of the decreasing quality of the clarifier effluent.

Effects on the Aeration Process—Some of the effects of returning the excess activated sludge to the raw sewage on the aeration process were as follows:

1. Due to the classification of the excess activated sludge in the primary clarifier, previously noted, there is a tendency to waste only the heavier activated sludge particles and to retain the lighter floc in the activation system. This tendency is not serious during ordinary operation but during periods of bulking when additional air input and a higher gravity of sludge is grievously needed in the final clarifiers it is distinctly disadvantageous.

2. The increase in the suspended solid content of the settled sewage causes sludge to accumulate faster in the aeration tanks. This in turn increases the amount of excess sludge to be wasted which further increases the amount of solids in the settler effluent. This vicious cycle becomes especially aggravating when bulking sets in and the sludge settles less effectively in the primary clarifier and increases the amount of sludge in the aerators. To the contrary, it is at such times desirable to appreciably reduce the sludge in the aerators in order to decrease the load on the aeration process and also to preclude floc being carried away in the final effluent because of its poor settling qualities.

3. The increased oxygen demand of the settled sewage puts an increased load on the aeration process that appreciably increases the cost of operation provided increased aerating capacity is available. At Salinas we have found it necessary to use about 4.8 cubic feet of air per gallon of sewage when wasting the excess sludge to the primary clarifier and it is also frequently necessary to use considerable hydrated lime in the aerators to adjust pH value and to assist the final settling process. This spring we discontinued attempting to concentrate our excess sludge and simply pumped it to an isolated area where it was lagooned. During that time we were able to operate with about 0.4 cubic feet less air per gallon of sewage thus saving about $3.90 per million gallons in power costs. We were also able to very materially reduce the amount of lime used thus saving an additional $1.90 per million gallons. Therefore the total saving due to discontinuing the wasting of the excess sludge to the primary clarifier was $5.80 per million gallons of sewage treated.

Evidence Deduced from Laboratory Experiments

It would be interesting to know whether the activated sludge actually does coagulate or absorb some of the colloidal matter and so assist sedimentation when it is introduced into the raw sewage or whether the higher percentage removals of suspended and oxygen demanding materials are simply due to the well known phenomenon that, other things being equal, the greater the concentration of suspended matter in the crude sewage the greater will be the percentages of suspended and organic matter removed by sedimentation. The writer made a few laboratory experiments (for other purposes) that appear to indicate that the sludge actually does have some precipitating action as suggested by Lumb[9] and Donaldson[6]. The experiments consisted of mixing settled sewage and activated sludge drawn from the final clarifiers in the proportions of 2.13 to 1 by volume and allowing the mixture to settle in glass graduates for one hour. The 5-day oxygen demand of the settled sewage and of the supernatant liquor in the graduates were then determined. It may be seen from Table II that the actual reduction in B. O. D. averaged 44.0 per cent while if the mixture had consisted of settled sewage and distilled water in the same proportions the *theoretical* reduction in B. O. D. due to dilution alone should have been but 32.0 per cent. Since the liquor in the sludge used unquestionably had some oxygen demand itself it is obvious that the sludge floc must have removed much of the colloidal matter from the sewage. However, in actual practice, a much smaller proportion of activated sludge is mixed with the sewage so nowhere near as great a reduction in organic matter can be expected.

TABLE II—Reduction in Oxygen Demand of Settled Sewage Accomplished by Mixing with Activated Sludge in the Proportions of 2.13 to 1 and Settling for One Hour in Liter Graduates

Initial 5-Day B.O.D. of Settled Sewage	5-Day B.O.D. of Supernatant Liquor from Sewage-Sludge Mixture	Per Cent Reduction in Oxygen Demand	Per Cent Volatile Matter in Sludge on a Dry Basis	
			Initially	Finally
384 p.p.m.	221 p.p.m.	42.5	71.13	72.84
374	204	45.4	77.72	78.09
Average		44.0		

Discussion and Conclusions

The experiences obtained at Salinas show that although the wasting of excess activated sludge to the primary clarifier greatly reduces the volume of sludge to be digested and hence improves the functioning of digestion processes it increases the solid content and oxygen demand of the settled sewage and thus increases the cost and difficulty of operating the activated sludge process. The practice transfers the difficulties from sludge digestion to the treatment of the liquid portion of the sewage. Although the literature is very indefinite, it seems probable that the practice of so wasting the excess sludge has a tendency to produce similar effects at other plants where it is used. The degree to which this tendency will be noticed depends primarily upon (a) the amount of sludge so wasted, (b) the rate at which it is wasted and (c) the design of the primary settler.

The amount of sludge to be wasted is dependent upon the character of the sewage and the functioning of the aeration process. Aeration is far more costly to operate than sedimentation. Therefore, it is desirable to have the control of aeration as independent of the functioning of sedimentation as possible. Wasting in this manner makes aeration more, insteal of less, dependent on sedimentation.

Very low rates of wasting would reduce the undesirable effects on aeration and secure greater concentration of the sludge. However, at plants that handle but small flows it is difficult to design equipment for wasting that is free from clogging difficulties. These difficulties necessitate constant attendance while wasting. Where plants can be maintained with only part time attendance, the advantages to be gained by decreased rates of wasting may not be sufficient to warrant the expense of additional operators. Reducing the time an operator was on duty from 17 to 9 hours a day made possible a saving of $8.00 per million gallons of sewage treated at Salinas. Since the total saving by not wasting sludge in this manner at all was only $5.80 per million gallons it is evident that the hiring of an additional operator would not be justified solely to make possible a lower rate of wasting.

It is quite commonly believed that relatively shallow tanks of large surface area are most efficient for settling crude sewage. Such tanks provide little sludge storage space and are normally operated with sludge depths of only a few inches. On the other hand deeper tanks are generally provided as final clarifiers at plants employing the activated sludge process. The lower portion of these tanks is considered as sludge storage space and is utilized to assist in concentrating the sludge. Experiences

at Salem, Ohio,[1] and at Salinas show that when excess activated sludge is wasted to primary settlers it is necessary to maintain sludge blankets 1 to 3 feet deep to secure sludge concentration. This indicates the need of deeper primary tanks where this practice is to be followed. It would also appear necessary to have as long a detention period in the primary settler as is provided in the final settlers.

Almost all activated sludge plants are more or less subject to sludge bulking difficulties. When bulking occurs this system of disposing of excess sludge partially or completely fails. Both the solid and the B. O. D. content of the settled sewage are greatly increased, thus making the control to overcome bulking more difficult. At the same time the sludge in the primary clarifier concentrates very little, thus partially defeating the primary purpose of the practice. In general it appears that some means of concentrating the excess sludge without introducing it into the primary sedimentation tanks is to be desired. Decantation has been tried at some places but has not proved very successful. Lagooning is not ordinarily considered a satisfactory means of disposal. It has been in use at Salinas for only three months and so far we have encountered no difficulties with it. We are fortunate in having available a very well isolated lagoon that may be utilized without any greater pumping cost than was required to pump sludge to the primary clarifier.

A Promising Method of Concentrating Excess Sludge

Goudey and Bennett[8] have developed a new method of concentrating wasted activated sludge which although requiring the use of a separate clarifier and about 25 lbs. of chlorine per million gallons of sewage treated is not particularly costly. It entirely eliminates the introduction of excess sludge into the crude sewage, provides sufficient residual chlorine to sterilize the entire effluent and, at Los Angeles, gives much better concentration of the sludge particularly during periods of bulking. Preliminary estimates show that their method would cost from $3.00 to $3.50 per million gallons including maintenance and depreciation at Salinas as compared with a cost of $5.80 per million gallons for wasting the sludge to the primary clarifier. In the event that lagooning should prove to be unsatisfactory we are planning a trial of the method at Salinas.

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N. Y. State Sewage Works Ass'n Met in White Plains, N. Y.

The New York State Sewage Works Association held its Fall meeting at the Hotel Roger Smith in White Plains, N. Y., October 27-28, 1933, President A. F. Dappert presiding. One hundred and sixty members and guests were registered.

Alexander Potter, Consulting Engineer, New York City, in his paper "Joint Sewerage Works Serving Twelve Municipalities," illustrated by slides and movie films, presented many unusual features of a large sewerage project. Discussion on this paper was led by W. W. Young, Consulting Engineer, New York City. A paper on "Chemical Precipitation as an Adjunct to Sewage Treatment at Freeport, L. I." by Lawrence L. Luther, manager of the Department of Sanitation of Freeport, was received with much interest, and discussion was opened by Weston Gavett, Consulting Engineer of New York City, and Robert N. Clark, Sanitary Engineer of Innis Speiden Company, New York City. Morris Cohn, Sanitary Engineer, Schenectady, presented a brief abstract of the Annual Report on the operation of the Schenectady sewage treatment works. W. J. Scott, Director of Sanitary Engineering, Connecticut Department of Health, gave a timely paper on "Regulations Pertaining to Qualifications of Sewage Works Operators," covering the Connecticut aims and experience. Discussion prepared by F. D. Stewart, Principal Assistant Engineer, Ohio State Department of Health, was read and further discussion was presented by E. B. Besselievre of the Dorr Company, New York City.

At the luncheon Herman W. Merkel, General Superintendent of the Westchester County Park Commission, was the principal speaker, usuing as his subject "Landscaping and Beautifying Sewage Treatment Works."

The afternoon was devoted to a symposium on the organization, construction and operation of the Westchester County Sanitary Sewer Commission projects by W. W. Young, Consulting Engineer of the Commission, and his associates.

"Interurban Sanitation — Promotion, Legislation, Financing and Organization," by W. W. Young, Consulting Engineer.

"County Sanitary District Determination and Sewer Easement Acquisition," by F. J. Laverty, Project Engineer.

"Trunk Sewer and Tunnel Location, Pumping Plants, Specifications and Construction," by F. C. Zeigler, Project Engineer.

"Water Tightness in Sewers and How to Secure It," by E. C. Hallock, Chief Inspector.

"Fine Screening, Incineration and Sterilization Plant Construction and Features," by J. W. VanDenburg, Project Engineer.

"Plant Operation and Effluent Disposal by Dilution," by W. R. Schreiner, Bacteriologist and Chemist.

Evening Session

Following a brief talk by I. W. Mendelsohn on "Sanitation in the Far East," the Round Table discussion was opened by Messrs. W. A. Hardenbergh, W. H. Larkin and G. A. Mowbray.

At the Round Table breakfast Saturday, Morris M. Cohn and C. C. Agar conducted the Question Box.

A. S. BEDELL,
Secretary-Treasurer, N.Y.S.S.W.A.

CONVENTION OF CALIFORNIA SEWAGE WORKS ASSOCIATION*

THE 6th Annual Convention of the California Sewage Works Association was held on September 18th and 19th in Santa Cruz, California. A divertisment of the convention was a motor trip to the oldest known red-wood grove which is located in Big Basin of the Santa Cruz Mountains some 30 miles distant. Some of the remarkable specimens of red-wood trees are known to be 5,000 years old—the tallest being 350 ft. high and base diameters of 20 ft. are not uncommon.

The Santa Cruz Screening Plant and Ocean Outfalls

Returning to Santa Cruz the party inspected the sewage works of the city which disposes of its sewage by fine screening and discharge through ocean outfall lines terminating (originally) at points 2,000 ft. off shore. Due to earth movement, shifts in the ocean floor and storms, one outfall line had been broken at about the midway point and now discharges some 1,100 ft. off shore. The Screening and Pump Station (3 m.g.d. capacity) is equipped with two 6 ft. diameter Dorrco rotating fine screens—the screenings being drained and disposed of on land within trucking distance. Automatically operated pumps discharge the screened sewage to the ocean outfall lines. During the visit a demonstration was made with dye to show the rate of travel of sewage through the outfalls and its dispersion in the ocean currents around the outlet.

"Performance of the Santa Cruz Ocean Outfall Sewers"—RAY FOWLER, City Engineer, Santa Cruz, Calif.

Later in the meeting Mr. Fowler described the ocean outfall lines and recited some of the difficulties which had been experienced with breaks and leaks. The original installation has consisted of 16-inch lines terminating 200 ft. apart and 2,000 ft. off shore, under 40 to 50 ft. of water. These lines, constructed of 16-inch wrought iron pipe of ½ to ⅜ inch wall thickness, had been protected with a 2-inch covering of reinforced gunnited cement mortar and the 500 ft. nearest shore line was further protected with a sheathing of 20-inch corrugated iron pipe. The first break in the lines had been near the shore line and repairing by welding proved satisfactory. After 3 years of service leaks were suspected as being caused by several storms. Divers sent down reported the central portion of one line to have been moved 500 ft. out of position, with a break occurring where a 60-ft. span had been robbed of support. About $15,000 had been spent in repairs and placing new supports under the line and placing improved anchors in excavated trenches. The break 1,100 ft. off shore had occurred subsequently but would probably not be repaired on grounds that continued expense in maintaining these outfalls was of questionable justification.

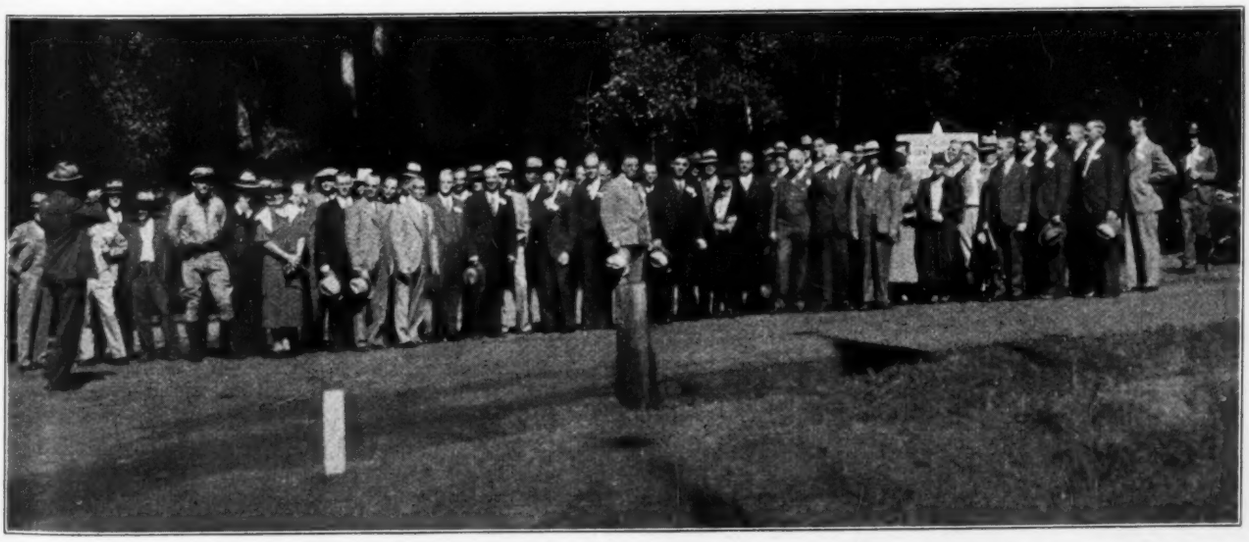
Multiple Stage Sludge Digestion

"Recent Experiences With Multiple Stage Digestion of Sludge"—A. M. RAWN, Assistant Chief Engineer, Los Angeles County Sanitation Districts, Los Angeles, Calif.

Mr. Rawn recounted experiences with a new principle and design of sludge digestion tanks constructed at their main disposal plant. Digested sludge particles being of higher gravity than undigested or partially digested particles (and therefore usually at the bottom of digestion tanks). The new digestion tanks had been designed to make use of this natural performance and to cause digested sludge and inert materials to move through the tanks more rapidly than the partly digested materials. To procure this effect, multiple stage digestion had been resorted to by constructing two batteries of 4 tanks each with gradually decreasing elevation of flow line in order to insure movement of solids through the series by gravity. All tanks had been designed for providing artificial heat and collection of sludge gas for that purpose.

Each of the four tanks in one battery (connected in series) were partitioned to provide three compartments interconnected at the bottom by a clear opening under the partition walls terminating 1 foot above the floor.

*For the report covering this Convention, we are indebted to A. Carl Beyer, District Representative, Wallace and Tiernan Company, San Francisco, Calif. We regret the report reached us just after our October issue had been closed and it, therefore, had to be held over for abstracting for this issue.—*Editor.*



California Sewage Works Association in Redwood Park, near Santa Cruz, Calif.

Into No. 1 tank fresh solids had been distributed to the outside compartments in which the scum remained until later deposited as bottom sludge. The bottom sludge moved through the bottom openings and into the center compartment, from which it passed to No. 2 tank—the input being equally divided between the two outer compartments at the top—and thence by way of the under passes to the center compartment of No. 2 tank and so on through the eight tanks. Digested sludge was withdrawn only from the center compartment of the final tank in the series, thereby providing eight opportunities for segregation of solids by gravity.

Adding an average of 1 m.g.d. of mixed crude and activated sludge from an average sewage flow of 14.3 m.g.d. would theoretically require 9.5 days for sludge to pass through the battery of digesters but on analysis it had been evident that whereas the liquid must have passed through in the 9.5 day period, the segregated solids had required on the average of 14.7 days to pass through and some of the solid material had been much longer in working its way through. Exhaustive analyses had indicated an average moisture content of the digested sludge (produced from crude and activated sludge mixture) to be 96.23 per cent—the 3.77 per cent of solids having a volatil matter content of 52.9 per cent. That had represented a 53.7 per cent reduction of volatil solids. The finished sludge (dried on open beds to a moisture content of 56 per cent in 19 days) was then macerated to produce fertilizer. Assuming a year round drying period of 28 days on the beds as an average, 1.25 sq. ft. per capita is adequate to care for all sludge produced. Supernatant liquor was being strained through special drainage beds, the effluent going to the crude sewage. Gas production had averaged 6.9 cu. ft. per pound of volatil solids added or 1.43 cu. ft. per capita. The cost of the multistage digesters, equipment and drying beds had been $175,550 and the cost of operation, supervision, depreciation, interest and replacements was estimated at $3.41 per ton of (dry weight) digested sludge produced. The sale of the sludge cake brought in $20.00 per dry ton.

"Removal of Ammonia from Sewage by Zeolites"—M. J. Conover and O. C. Ralston, The Arizona Minerals Corporation.

Messrs. Conover and Ralston discussed the future possibilities of ammonia recovery from sewage by passage of a clarified effluent through zeolite beds as had been demonstrated by the Guggenheim Laboratories (in the process described in Water Works and Sewerage, Vol. 79, p. 420, and Vol. 80, p. 50) and likewise at the Griffin Park Experimental Sewage Plant at Los Angeles. The ammonical nitrogen plus other forms of nitrogen compounds was removed and held by the zeolite—later to be displaced by brine treatment, as in the case of calcium and magnesia displacement in softening practice. The ammonical brine treated with lime released the ammonia for distilling off and recovery. Ammonia at 5 cents per pound would yield a return of from $3.75 to $20.00 per million gallons of sewage treated.

R. F. Goudey, Engineer in Charge of the Griffin Park Station, disclaimed any credit for having developed the ammonia removal process, which had originated in the Guggenheim Laboratories in New York. He considered the process to be of interest only to the larger municipalities and thought it might be utilized in conjunction with a partial activation process to build up ammonia without oxidizing much of the ammonia to nitrite or nitrate.

"Methods for Determination of Chlorine Demand of Sewages"—A. C. Beyer, Wallace and Tiernan Company, San Francisco, Calif.

Mr. Beyer discussed the three methods used in determining the chlorine demand value of sewages and industrial wastes and concluded that it was highly desirable in view of the increasing use of chlorine to have a standard method of procedure for making the demand test. Variables in technic would produce quite variable demand values. It was a fact that in practice as well as in laboratory tests, the greater the chlorine addition in excess of the minimum quantity which was required to produce a faint residual the greater would be the chlorine consumed by the constituents present in the sewage, waste, etc. Likewise, the technic followed in adding the chlorine solution to samples, the alkalinity or acidity of the chlorine solution and the method of using the indicator would all have a bearing on results secured.

The oldest procedure employed was that evolved by L. H. Enslow in which a standardized chlorine solution was added until a small test specimen removed from the titrated sample and added to a tiny globule of ortho-tolidin reagent on a paraffinned white surface produced a faint yellow color within a few seconds. Allowed to stand for 5 minutes the titrated sewage should reveal a distinct yellow when a small portion was treated with a few drops of ortho-tolidin solution. A procedure later developed consisted of adding a standardized chlorine solution to a series of sewage samples (at least 4) in increasing quantities. In this test the maximum dosage must be sufficient to produce some residual chlorine after a contact period of 5 minutes or longer before removal of the specimen to make the ortho-tolidin test quantitatively by the comparator method. The residual observed in p.p.m., when deducted from the dosage applied, revealed the minimum chlorine demand value. An increase in chlorine dosage to produce residuals of greater magnitude would reveal increasing chlorine demands and it would, therefore, be necessary to work toward minimum chlorine demand values. The requirement to produce whatever residual might be desired at the end of a stipulated contact period should be arrived at by adding to the minimum demand. For the purpose of estimating strengths of sewages and comparing chlorine demands at several points on a system the use of the minimum demand determination was to be preferred.

Mr. Beyer said, the use of the series demand procedure with starch and iodide indicators had proven satisfactory provided no acid was added in the test and a marked blue color was observed. He commented on the effect of the alkalinity of standard chlorine solutions in respect to chlorine consumption by constituents of the samples tested. Highly alkaline solutions would yield lower demands than acidic, neutral or faintly alkaline solutions. Faintly alkaline solutions were to be preferred for general use because of their greater stability than chlorine water, whereas, the availability and speed of reaction of chlorine content was about the same as that of chlorine water. He felt that, from a practical standpoint, the series-demand was the preferred test to be used in conjunction with the comparator method to determine residuals after 10 minutes or more of sewage-chlorine contact and a deduction of the residual from the total dosage applied. The spot test might be used to roughly estimate the demand and would serve as a preliminary to making the more accurate test by the series method wherein the various volumes of chlorine solution should be added as a quick single operation during stirring of the sample.

A. P. Banta and F. D. Bowlus remarked on the value of chlorine demand tests for determining the chlorine dosages required to produce the desired result at the least expenditure for chlorine. Routine testing for chlorine demand on the Los Angeles County system together with hydrogen sulphide, pH and temperature determinations had resulted in a saving of between $400

and $500 a month for chlorine used in odor control. Their opinion, and that of others, was that a standardized method for determining chlorine demands was highly desirable.

"Difficulties with the Utilization of Sludge Gas"—A. J. SMITH, Black and Veatch, Engineers, Los Angeles, Calif.

Mr. Smith called attention to the destructive effects of sludge gas on furnaces and surrounding metals due to sulphide attack and sulphuric acid production when burning sludge gas containing sulphide. He pointed out the successful use of sludge gas in operating gas engines at Rockville Center, L. I., and elsewhere. A cast-iron boiler had been corroded through after three years of use at a southern California plant. Alleghany metal and other alloys had stood up very well at the Whittier plant and Toncan metal had proven superior to wrought-iron for the heating coils at the Pomona plant. When burning sludge gas even slight pressure variations were objectionable and he, therefore, advocated the use of gas-holders or floating covered digesters as reservoirs and pressure regulators.

In discussion, the fact was brought out that sludge gas could be purified by such means as are employed by utility gas producers and that the use of sludge gas was not a difficult problem when the difficulties were understood. The use of a scrubbing tower and chlorine were suggested as methods of removing the sulphide from the gas. R. F. Goudey advised against the use of automatic temperature control equipment on sludge gas burners, because the resulting start and stop operations due to condensation in the flues had not worked out well with sludge gas.

Symposium on Operating Problems

W. A. ALLEN, Assistant Superintendent of the activated sludge plant at Pasadena, Calif., reported that insertion of transverse wooden baffles in the aeration tanks had improved the aeration efficiency and "bulking" of the sludge had been eliminated. Recent tests had indicated a diffuser plate to tank surface ratio of 1 to 10 had been as satisfactory as the 1 to 6 ratio used prior to installation of the baffles. Compressor noises had been materially reduced by the simple expedient of surrounding the air intake with a red-wood tank and encasing the air lines in concrete. The addition of lime to the aeration tanks had not corrected sludge bulking.

S. M. BENNETT, Chief Operator, Experimental Sewage Plant, Los Angeles, Calif., had used a portable diaphragm pump on the suction of centrifugal sludge pumps as a means of clearing the pump. They had also found the addition of ferric chloride to the sewage to be helpful in handling certain industrial wastes and the resulting sludge had been more concentrated.

R. F. GOUDEY said that aeration tanks giving trouble could be put back in order by adding lime or other coagulating chemicals followed by a rest for settling with the air completely cut off.

C. TENNANT, Chief Operator, Los Angeles County plant, had found lime additions to the aeration tanks an uneconomical method of correcting aeration tank difficulties. Cleaning diffusor plates by application of water under pressure to the air lines had been effective. T. R. HASELTINE on the other hand had found lime application to the Salinas aeration tanks quite helpful.

A. C. BEYER directed attention to the improved operating conditions at the Phoenix, Arizona activated sludge plant which had resulted from chlorination of mixed sludges (crude and activated) entering a concentration tank. As a result a much thicker sludge could be had for the digesters, thus cutting down the volume of supernatant liquor to be disposed and lessening digestion tank disturbance. He also referred to the advantage gained by chlorinating supernatant liquors before return to the crude sewage.

A. E. GILKEY, superintendent of Sewage Treatment, Roseville, Calif., related experience with profuse seasonal growths of sphaerotilus in the sewers. Prof. C. G. Hyde said that such growths were indicative that the sewage was dilute and the water soft.

New Officers

The following officers were elected to serve during the coming year:

President—D. C. McMillan, City Engineer, Ventura, Calif.

1st Vice-President—T. R. Haseltine, Supt., Sewage Disposal Plant, Salinas, Calif.

2nd Vice-President—A. M. Rawn, Asst. Chief Engineer, San. District of Los Angeles County.

Secretary-Treasurer—E. A. Reinke, Asst. Engr., State Dept. Health, Berkeley, Calif.

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Maryland P. W. Projects Being Pushed Through

In an editorial on "What State Sanitary Engineers Have Done" in *Water Works and Sewerage* for September several states were listed in which progress in getting water works and sewerage shaped up for applications had been particularly impressive. Maryland, through an oversight, was not included. When one examines the lists of projects for which applications have been filed with the State (P.W.A.) Engineers, and compares this with those approved, Maryland makes a most satisfactory showing.

There have been applications for 38 projects passed on to Washington by the State (P.W.A.) Engineer of Maryland, of which 24 (63 percent) have been approved to-date and 11 of the 24 have been allotted the full amounts applied for. Based on a ratio of applications approved to application filed, Maryland probably tops the list.

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Muskrats: A British Water Works Problems

Considerable anxiety has been caused to water works undertakers by the escape of muskrats from a farm in Shropshire. Muskrats were brought into this country in October, 1929, for breeding purposes with a view to supplying a fur (known as musquash) for the adornment of the ladies. This animal has now been officially exiled from the Kingdom. Alas! it is easier for Parliament to pass such a measure than it is to execute its purpose. It is estimated that there are over a million muskrats loose in the land, and as we are in the breeding season this number will be speedily increased. Owing to the burrowing habits of these pests it will be realized that considerable anxiety may be apprehended to certain types of reservoir banks. A pamphlet and memorandum have been issued by the Ministry of Agriculture and Fisheries dealing with this danger. A trapping campaign has been going on in Shropshire and the adjoining counties for some months, but the results are low and the costs high. It would seem that some national and energetic campaign will be necessary. The longer it is delayed, the greater the expense to be incurred in fighting this prolific nuisance.—Extract from the presidential address of G. M. Robertson, President, British Water Works Association.

EDITORIALS

Evaluating Chemical Treatment of Sewage

POSSIBLY, because of some degree of dissatisfaction with purely biological processes of sewage treatment for one or another reason, but more probably as the result of a recognized need for a process which will produce a degree of purification intermediate between that resulting from ordinary sedimentation and that procurable from the activated sludge or other biological processes, engineers and chemists have been recently showing a genuine interest in the newer developments in the treatment of sewage by chemical-mechanical processes.

As a result, one finds chemical treatment of sewage the major item of interest on recent programs of sewage works associations and a topic creating considerable speculation and discussion among sewerage men generally as well as municipal authorities and industrialists. The question of the day seems to be—"What is the future of chemical processes in the treatment of domestic and industrial sewages?" As time goes on the situation is clarifying itself and the value, as well as the limitations, of such processes are becoming better understood and more definitely apparent. There seems to be ample evidence that the known processes, involving chemical precipitation in one or another form, will produce a degree of treatment amounting to between 60 and 75 per cent purification when evaluated in terms of reductions of biochemical oxygen demand (B.O.D.) values; that rapid filtration effects further removals and materially improves the appearance of the effluent and that chlorination in addition will further increase the oxygen demand removal to an overall figure of 70 to 85 per cent. With efficient coagulation and flocculation and effective filtration, it goes without saying that the removal of suspended solids can be made highly satisfactory.

In the case of one process which has been under development by the Guggenheim Laboratories, first on New York sewage and subsequently subjected to test and further development for 9 months on Chicago sewage under surveillance by authorities of the Chicago Sanitary District, the removal of organic matter and suspended materials has been of the order of that effected by the better performing activated sludge plants.

In commenting on the Guggenheim process, Dr. F. W. Mohlman, Chief Chemist of the Chicago Sanitary District, as reported elsewhere in this issue—(see the "digest" of his paper presented before the Central States Sewage Works Association)—stated that this process was the most varied of the several under development and likewise, because of the actual removal of soluble and pseudo-soluble nitrogenous compounds by zeolite filters, it had produced the highest purification efficiencies of any, viz., a removal of 90 per cent of the oxygen demand value and 95 per cent of the suspended solids on the average. Comparing such results with average removals of 95 per cent oxygen demand value at Milwaukee and 92 per cent at Chicago and Indianapolis it seems evident that chemical treatment, in so far as performance is concerned in at least one process, can be made to produce a high order of efficiency. What the engineer will wish to know is the relative cost per million gallons and the published cost data on the demonstrations at Chicago will be watched for with considerable interest.

Of the several other processes under test or development the Laughlin process has had the most complete demonstration, both at Coney Island, N. Y., and Dearborn, Mich. Unfortunately, the Dearborn (large plant) results have not been subject to fair evaluation because of the peculiar operation, involving the precipitation of solids from a fresh sewage in small volume into which large volumes of partially digested sludge from a distant plant have been discharged. Other processes advocated having been less adequately demonstrated is responsible, perhaps, for the comments of Dr. Mohlman that results from chemical processes had on the whole been meager and unconvincing. And, F. H. Waring, Chief Engineer of the Ohio Department of Health, added (in discussion reported also in this issue) that the "bunk" in some of the claims advanced by a few proprietors of chemical processes was to be deplored. This circumstance is unfortunate when one considers, as does Mr. Waring, that proven processes, based on chemical treatment, are to have a useful place in the scheme of waste disposal if properly evaluated and chosen on their merit for conditions to which they are suited—not proposed as a universally applicable method of waste treatment for any and all conditions. Expressed in common language, what Mr. Waring implied was that "every tub must stand on its own bottom," or in other words each individual stream pollution problem is a matter for separate consideration. If a chemical process will serve to produce the required quality of effluent to satisfy the condition at hand, and at a cost less as compared with established processes, or should the facilities for controlling the degree of purisfication be more dependable and subject to greater flexibility, than is true of established processes, then the chemical processes will be selected on their respective merits. It is on this basis that engineers will evaluate and select chemical treatment processes—not on the basis of an appealing effluent to the eye of the Mayor or the Chamber of Commerce; nor upon the claims of patents filled with high-sounding professional-jargon taken from text books on colloidal and physical chemistry.

The proprietors of chemical-mechanical processes would do well to realize these facts and prepare themselves, as has previously been suggested in past editorial comment, to advocate their equipment and process only where it can be demonstrated as adequate or superior to another. To do this, will necessitate sales engineering of the highest sort—not the political high pressure variety. The sales engineer will require a working knowledge of stream conditions involved, nature of the sewage and, most certainly, the chemicals required for treatment, before his firm can give an intelligent and dependable estimate of plant costs and the all important operating costs. He must be in a position to show comparative estimated costs from other methods, or at least be able to analyze costs and conditions with the engineers representing the state and municipality. The proprietors of chemical treatment processes will do well to consider the fact that they must convince the Consulting Engineer, the City Engineer and the State Engineer that the process is sound, economical and sufficient. That can best be done by engineers who are chemically minded, but, more or less, capable of understanding the biologics of streams under varying conditions.

That chemical treatment of sewage in one form or

another has a feature, seems to be becoming more widely accepted as time passes. Chemical conditioning of sludges as an aid in dewatering operations is already rapidly becoming established; and, with sludge incineration perfected, dewatering of sludges on vacuum filters will become the most satisfactory as well as, what appears to be, the most economical means of disposal of sludges not subject to economical processing into fertilizer.

The most attractive, and immediately effective, use of chemical treatment would appear to be in conjunction with existing treatment plants. Further, if the process is to be used alone in new installations it may be arranged for the addition of secondary treatment in some form at a subsequent time, if and when required. Everyone, with operating experience, appreciates that reduced peak loadings on biological plants cause these plants to function efficiently, smoothly and at a reasonable cost of operation. Instead of using the plant bypass, or the "temporary emergency relief outlet," to relieve overload conditions, the use of preliminary chemical precipitation, to remove the "tough" parts of the sewage and leave the more "tender" morsels for biological attack, appears on its face an interesting way of relieving the oxidizing aerobes of digestive disturbances.

That such a scheme is practical is indicated in the statements of L. F. Warrick (reported in this issue) that chemical precipitation precedes sprinkling filters at certain plants treating cannery wastes in Wisconsin to reduce loadings and prevent odors and to reduce the required size of unit. Dr. Mohlman, too, calls attention to the probable value of chemical precipitation for reducing heavy loadings and combating industrial waste effects on existing plants, thus increasing the capacities and efficiencies of biological units. In this opinion F. H. Waring agreed as to this immediate and most promising usefulness of chemical treatment, as did no less a sewerage authority than Langdon Pearse, Sanitary Engineer of Chicago.

The fact that in chemical treatment there is no amortization, interest or depreciation charge to be considered in its use, it is a process—the overall cost of which is determined alone by the frequency of use and the work performed. It, therefore, has an appeal as being economically the soundest available process for producing temporary or seasonal requirements at existing and future plants.

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The Retirement of Sir Alexander Houston

SIR ALEXANDER HOUSTON, having completed 28 years of fruitful work as Director of Water Examination for the Metropolitan Water Board of London, has notified the Board of his wish to resign from active duty at the end of the present year.

Internationally known, as a scientist and water purification expert of outstanding qualifications, the city of London will not be alone the loser of a man of such productive capacities, the entire water purification profession will feel the loss as well.

Outstanding in his contributions, have been the studies applied to the chlorination of water and he, indeed, has won for himself the title of—"Father of Chlorination"—because of the introduction of chlorination of water in England prior to establishment of the process in America. To evaluate the worth of this trail-blazing in a water treatment process, considered now the world over to be an essential part of water treatment processes, is impossible. To estimate the savings in money and the more important savings in human lives and the reduction of sickness from water borne diseases which have resulted from his, then considered, "boldness" in chemically disinfecting a potable water supply in preference to other less secure, more tedious and more costly methods, can never be possible.

Then followed the problems of the "mawkish" tastes complained of by water consumers and the general upheaval of the medical men of London against chemical treatment. The treatment was discontinued for a time but Sir Alexander won his opponents over in the end and chlorination of the London water supply has been continuous ever since. The taste problem confronting the Metropolitan Water Board's Director of Laboratories was responsible for another important contribution to the water purification world—that of taste control. Concerning the investigations and results of studies made under Sir Alexander's direction, the Annual Reports of the Directors of Water Examinations for the past decade reveal much.

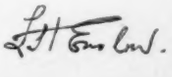
It was his work with ammonia application prior to chlorination for taste prevention, which led J. W. McAmis, Superintendent of Water Works at Greenville, Tenn., to try the process there. McAmis, in reporting on the process to the American Water Works Association said, that being no chemist he preferred to offer no scientific explanation for the results, but felt content to report that the process had worked satisfactorily and "was as simple as rolling off a log." The process of ammoniation so widely used in America today had had its start at Greenville and, like chlorination, had come across the ocean from Sir Alexander.

Then, too, he contributed the permanganation process for taste destruction, and too, the super-chlorination and dechlorination process was conceived in the Metropolitan Water Board Laboratories. Six Alexander will also be remembered for his now famous admonition to operators in trouble from tastes, which was in effect, that the fault lay in their "temerity" when the solution was instead to be found in chlorinatinon "boldness" and therefore in increasing the chlorine applied rather than reducing it, as was the natural inclination. That he was correct has been amply borne out in modern chlorination practices. Further, Norman J. Howard of Canada, formerly associated with Sir Alexander, proved the value of superchlorination and dechlorination on a large scale at Toronto.

These are but a few of the more important of the contributions of Alexander Houston of London to the science and art of water purification. It was because of such work that he was Knighted and few men can boast the additional honors which have been bestowed on the "Father of Chlorination"—Sir Alexander Houston, K. B. E., C. V. O., M. B., D. Sc., L. L. D., F. R. S.—we salute you!

We join in the resolution of this Board—that "it is our sincere hope that his relief from arduous duties will result in such improvement in his health as will enable him to enjoy for many years the rest he has so abundantly merited."

We hope more—we hope that he will pay a visit to us in America, that we may express our appreciation of his contributions personally and, in some appropriate manner, pay additional honor to him to whom honor is so richly due.



NEW EQUIPMENT AND MATERIALS

Revolving Brush Sewage Aerator

Sewage aeration by a revolving brush is one of the new methods of mechanically aerating sewage. The Brush Aerator, developed and first used in Holland, consists of a mechanically driven brush, rotating to form a spray on the surface of the aeration tanks, as pictured above. Its rotation in contact with the liquid surface also sets up a spiral flow through the tanks.

The Brush Aerator can be fitted to many existing or rebuilt tanks. And no piping, submerged parts, or accessory equipment is required. The Brush Aerator is mounted on the tank wall and forms a compact simple unit. The brushes turn outwardly from the supporting wall and induce a rotary motion in the sewage; this motion combined with a longitudinal flow through the tank turns the entire volume of sewage over and over in a spiral flow, constantly exposing a fresh surface to the spraying action of the brushes, and carrying around the innumerable fine bubbles of air produced by the spraying and churning action of the brushes as indicated in the illustration.

The Brush Aerator

Results so far obtained from existing installations indicate an extremely low consumption of power. Brush Aerators are low in installation cost, economical in power consumption and simple in construction and maintenance.

The Row Engineers, Inc., of 50 Church St., New York City, have radically improved the mechanical features of Brush Aerators and are prepared to supply these units to meet varying requirements. Descriptive literature will be sent upon request.

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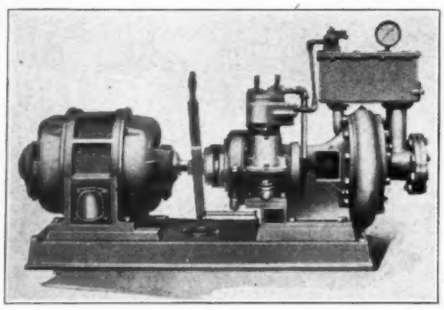
Ames Centrifugal Pumps

The Ames Pump Company (a division of the American Locomotive Company) New York City, have recently announced three new lines of centrifugal pumps designed for pumping sewage, drainage, or clean water delivered against low or high heads.

Particularly interesting, are the Ames Self Priming Pumps—a sewage pump being illustrated above. In the self-priming water pump the company stresses as of chief importance, the single moving element which circulates the seal water and also the adjustable opening (priming regulator), which may be set to keep the recirculated seal water down to the minimum requirement necessary for the priming operation. Thus the secret of the high efficiency rating of this self priming unit is revealed. It is apparent that efficiency results from the regulation of the primer unit which is available to satisfy every possible combination of suction lift and discharge head with a minimum of energy loss. These pumps may be operated with or without the primer functioning.

In the Self Priming Sewage Pump, priming is effected through operation of a piston-type dry vacuum pump which will prime and maintain the prime on pumps operating under as much as a 27 foot suction lift. Absolutely no water or sewage is needed for initial priming and the main centrifugal pump shaft operates the vacuum pump through a silent chain drive in oil. The priming unit is subject to continuous operation or automatic cutout as desired. The main pump is of the non-clog open impeller type which operates at speeds, not exceeding 1800 r.p.m. to provide quiet operation and long life.



Ames Automatic Priming Sewage Pump

"Ames Self Priming Centrifugal Pumps" are fully described in Bulletin 1100; "Ames Centrifugal Pumps" in Bulletin 1000 and "Ames Sump Pumps" in Bulletin 1200. All of these new bulletins are attractively prepared and written in non-wordy and clearly descriptive language, which should interest engineers and plant superintendents particularly.

For copies of these bulletins, address: Ames Pump Company, Inc., 30 Church St., New York City. Copies may also be procured from this office.

Fayar Non-Clogging Sprinkling Filter Nozzle

There are two conditions which cause lowered efficiency of the most rugged and dependable of sewage oxidizing devices—the sprinkling filter. One is poor sewage distribution—the other is no distribution at all. Faulty design of distribution appurtenances will cause the first difficulty: Clogged nozzles will cause both.

The Fayar "Non-Clog" Nozzle has been designed to avoid both difficulties, thereby increasing the efficiency of sprinkling filters. Costs of operation may be reduced by eliminating the "man-hour" charge against filters covering the cost of hand clearing or thawing out of clogged or partially clogged nozzles. That "one picture is worth 10,000 words" needs no proof in this description. The above illustration tells its own story—the clear opening; the distributing cone above and the whirling star "aerator" on the top to break up the liquid film into scattered droplets, appear to be self evident advantages. Non-clogging and self-cleaning nozzles are also non-freezing nozzles; effective distributing nozzles are efficient nozzles. The slogan of the producer, "Highest Efficiency at Lowest Cost" invites further inquiry.

Fayar "Non-Clog" Nozzle

For details and descriptive literature, address the Fayar Corporation, 39 Cannon St., Poughkeepsie, N. Y.

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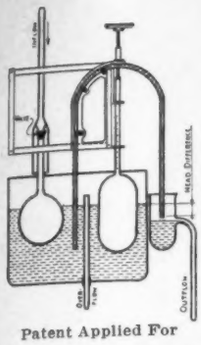
New R-C-W Bulletin

Roots-Connersville-Wilbraham, of Connersville, Ind., manufacturers of blowers, pumps, and meters, has just issued a new bulletin 23-B11 devoted to a description of R-C-W equipment as applied in sewage disposal plants.



Patent Applied For

Will Feed the Most Corrosive Chemicals

The Phipps & Bird Solution Feeder provides the ideal answer to the demand for a solution feeding apparatus with an accurate and constant feed, that is not effected by corrosive substances, that is easy to install and simple to operate, and that is economical both in initial and operating costs.

Let us send you detailed information regarding this new feeder. Whether your plant is large or small or only for experimental purposes, you will find it a most efficient apparatus for your requirements.

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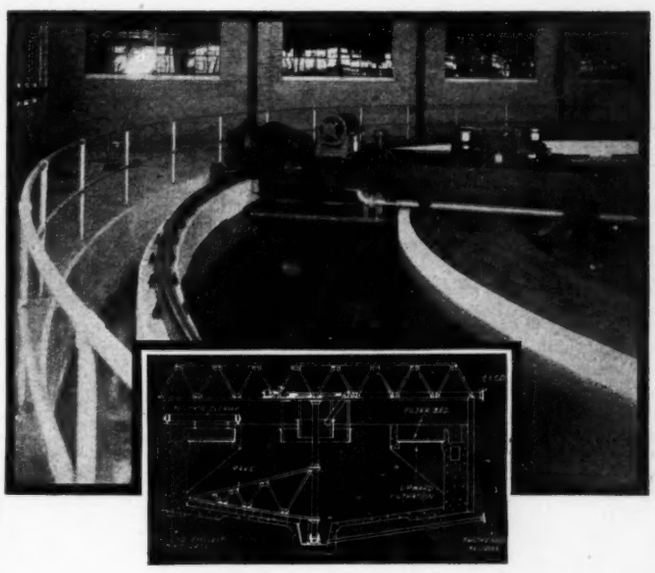
FILTRATION EQUIPMENT CORPORATION

LAUGHLIN CLARIFYING TANK

For the Better Removal of Suspended Solids from Sewage and Industrial Wastes



—Permits of usual sedimentation and thickening operations within a tank, at high capacity for a given tank size.

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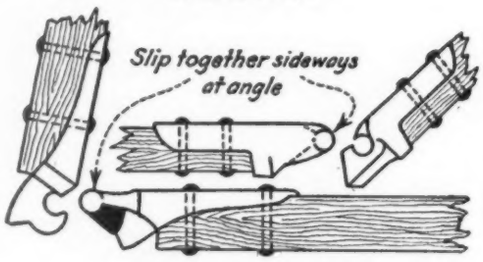

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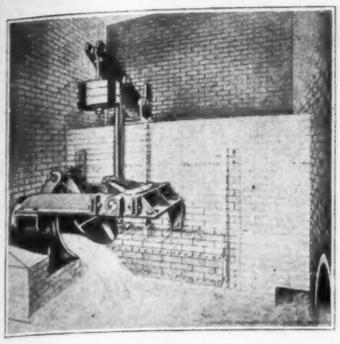

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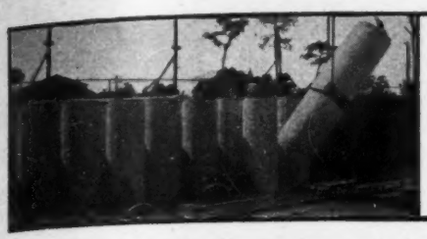

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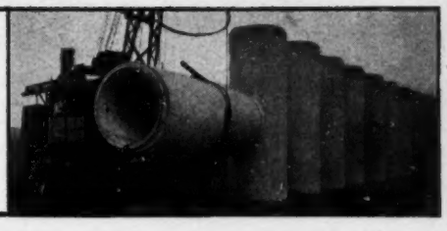

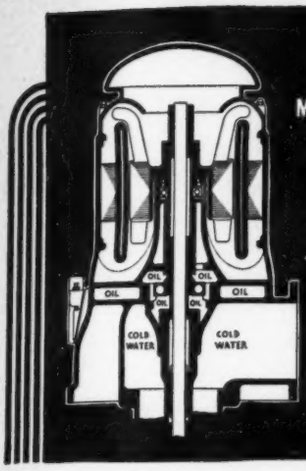

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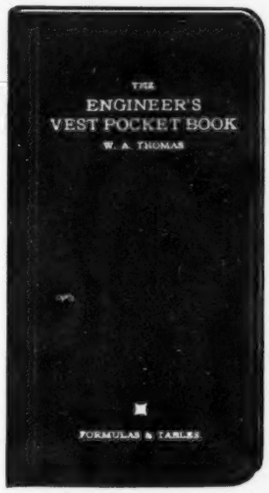

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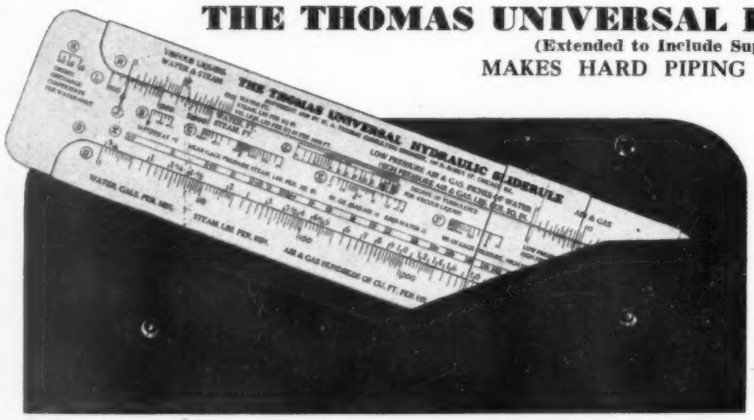

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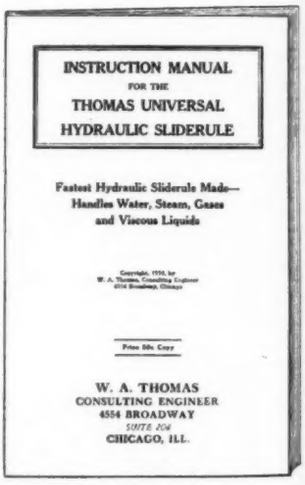

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